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Challenges and Solutions for Fostering Entrepreneurial Universities and Collaborative Innovation

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University-Industry Interaction: Challenges and Solutions for Fostering Entrepreneurial Universities and Collaborative Innovation

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The Institute Of Humanities Promoting The Dialog With The Steelworks Of Volta Redonda

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Abstract

Volta Redonda is a city with over 200,000 inhabitants where operates the plant of one of the largest industries in the world: the CompanhiaSiderúrgicaNacional (CSN). The location was strategically chosen for being situated among the three greatest metropolises of Brazil (map 2). In the 1960's a metallurgical engineering college was created in the locality (currently belonging to the Federal Fluminense University – UFF). In 2010 the Federal Fluminense University was expanded, with the creation of the Institute of Humanities (management, accounting and psychology courses, and law school).

With the establishment of the military dictatorship in Brazil, Volta Redonda has come to be considered a national security area (from 1964 to 1985), due to its strategic location. It happens that even after the return to democracy, the access to the plant facilities and the dialog with local community are still very limited, restricted to the use of skilled labor. Recent legislations in the field of environment forced changes in posture and procedures; however other social rights issues still lack further interaction, such as culture, education and health of workers.

The present article is the result of the studies developed in the Research Group "Human Rights, Communication and Media" (department of Law of the Federal Fluminense University in Volta Redonda) under the orientation of the Graduate Program in Sociology and Law (PPGSD-UFF – Programa de Pós Graduação em Sociologia e Direito, in Portuguese) turning to how communication – specially through University TV and internet – opens the possibility of transference and appreciation of knowledge.

Interaction with the CSN direction, and the democratization of its procedures for people, is a concern of the humanities, that wasn't priority for the engineering school.

The Federal Law n° 12.485/2011 section 32(XI) previses the creation of an academic channel in the cities which already have cable TV service available, like in Volta Redonda. It occurs that to this moment there's only one daily newspaper in the city and another biweekly one, and some commercial and community radio stations. The replicators of the main open TV channels have their headquarters in neighbor cities, so they end up prioritizing their local news.

It was found in the researches of opinion the availability of a local academic TV, interacting students with the practice of the market and class theory. Technical visit to the cable TV operator has found the need of installation of 3 km of optic fiber, interconnecting the UFF campus. Equipment and necessary installations to the proper operation of the TV are in process of acquisition. The potential public is about 16.000 houses.

Keywords

Dialog, Human Rights, communication, democratization of knowledge.

1 Introduction

The access to information is something indispensable for the intellectual development of a population. The action intents to enlarge this access, not only for the academic public, but also for general population originating from various social strata, enlarging the frontiers of the University, as it can contribute significantly in this process, assuming its role as an formation, mastery and cultivation of the human knowledge institution, especially in the city of Volta Redonda, which until the year of 1985 was treated by the federal government as “national security area”, and therefore subjected to a harder control, not only of the police force, but also ideological.

It’s known that the current Brazilian open TV program schedule, in a general way, do not privilege a discussion of a more intellectual nature in its audience, such as programs that become audience leaders in their schedule. Through the interaction of several academic knowledge dimensions, the action aims to enlarge and disseminate important intellectual information, not, again, only to the academic public, but also to the people theretofore away from this reality, through a programming that stimulates a more critical attitude on the citizens, giving enough weight to this action for social transformation.

Over 70% of the revenue of Volta Redonda is from taxes collected from CSN, however, the local population – except those who work inside the steelworks – have no knowledge of work practices developed in there, remaining out of its gates. Certain days and times pre-booked are destined for guided visits to sectors of the industry facilities. It’s understood that disseminating some of the internal procedures, such as the steel production chain, the storage and transport logistics, the means of environmental control of solid waste, of water and air, would be positive especially for students from the courses of the Humanities of the Institute of the Federal Fluminense University.

In the city there’s only circa 8.000 subscribers to cable TV (and circa another 8.000 clandestine ones) and two newspapers circulating in the newsstands. One is weekly and the other, named “*Diário do Vale*” (“Journal of the Valley”), nicknamed “*Diário Oficial*” *da CSN* (CSN’s “Official Journal”). There are a few radio stations, most with programming targeted for Gospel. There’s an experience of free internet connection, but it’s limited to the square in front of the City Hall and it has low traffic quality. In August 2010 the TV RIO SUL (South Rio TV), an open signal TV station, leader in its segment, initiated the transmission of the digital signal, on an experimental basis, in the cities of Resende and Volta Redonda, and by the end of 2013 it will probably be defined the expansion for the whole region. Recently, the city of Barra Mansa was contemplated with the digital signal, as well as in the other cities, experimentally.

There’s a whole legislation regulating the telecommunications sector, starting with the section 223 of the Federal Constitution, that states that the President can only make any radio or TV concession with the approval of the National Congress (according to recurring criticism, there would be a concentration of these concessions in the hands of few families, turning the sector in a true communications oligopoly), passing through the Brazilian Telecommunications Code (Federal Law n° 4.117/1962), the Federal Law n° 9.472/1997 (that states about telecommunication services organization, the creation and operation of a regulatory agency and other institutional aspects) or the Federal Decree n° 5.820/2006, that states about the implantation of the SBTVD-T (Portuguese abbreviation for Brazilian System of Digital Television – a technical standard for digital television broadcasting – created and used in Brazil and recently adopted in Peru, Argentina, Chile, Venezuela, Ecuador, Costa Rica, Paraguay, Filipinas, Bolivia, Nicaragua and Uruguay, based on the Japanese standard ISDB-T), establishes guidelines for the transition from the analogue transmission system to the digital transmission system.

The determination is that after 2016 all the programming be in the digital format mentioned above, yet the major TV networks are already airing the digital signal in anticipation, nevertheless, they must keep transmitting the analogue signal until then, maintaining the simulcast, transmitting simultaneously the same programming in two different systems.

The major networks have many affiliates in Brazil, and the signal that reaches the residences is the one that comes out of the closer retransmitter or repeater antenna. There are cases of cities that are distant from the retransmitters and will need towers equipped with digital signal transmitters; therefore the official calendar forecasts an enlarged deadline.

It has recently came into force the Federal Law n° 12.485/2011 that states about audiovisual media of conditioned access, replacing the old law, known as "lei do cabo" ("cable law"). This law in its Section 32 states that:

> *"The provider of the conditioned access service, in its providing area, independently from the distribution technology employed, must render, without any additional onus or costs for its subscribers, on all packages offered, channels of mandatory distribution programming for the following destinations:*
>
> *(...)*
>
> *XI – a university channel, reserved for shared use among the higher education institutions located in the city or cities of the service providing area, and that reserve must accord to the following precedence order:*
>
> *a) Universities;*
>
> *b) University center;*
>
> *c) Other higher education institutions."*

It occurs that so far none of the education institutions of the referred region have organized themselves in order to make possible the substantiation of this legal proposition. Being UFF the only high education federal institution in the region, it was up to the Humanities Institute to take the initiative in this direction, joining the other institutions under its leadership.

In this aspect, our institute is contributing with the heated debate about the issue of the democratization of communication means, that's happening in Brazil. A portion of the society preaches the need of regulation of the media, while another portion defends the free initiative in the sector. However, in a general way, and almost silently, regarding to this discussion, the Brazilian public universities fail to occupy the cable TV channels – guaranteed by the recent federal Law n° 12.485/2011 aforementioned. According to this Law, the universities hosted in cities with cable TV available, where they operate, have the right to occupy a channel and provide a programming and content produced by themselves in their academic environment, establishing a new relationship among civil society, state and market.

Next, we'll present a spatial contextualization and a brief literature revision, the methods to be employed, the results reached so far, the conclusions with some recommendations and the references.

2 Spatial contextualization

The zone of the Médio Paraíba Fluminense (Fluminense Medium Paraiba) is located in the southern section of the State of Rio de Janeiro, and comprises a dozen administrative town unities, namely: Barra Mansa, Barra do Piraí, Itatiaia, Pinheiral, Piraí, Porto Real, Quatis, Resende, Rio Claro, Rio das Flores, Valença and Volta Redonda.

The government zone of the Medium Paraiba is composed from micro regions of Barra do Piraí and the Medium Paraiba (figure 1, below), and it's limits are with the State of São Paulo, Minas Gerais and the regions of the coast and south central Fluminense South. Located in an strategic way between the two largest metropolitan zones of the country – Rio de Janeiro and São Paulo – the region concentrates a large economic potential and regional development, especially in the industrial activities and services.

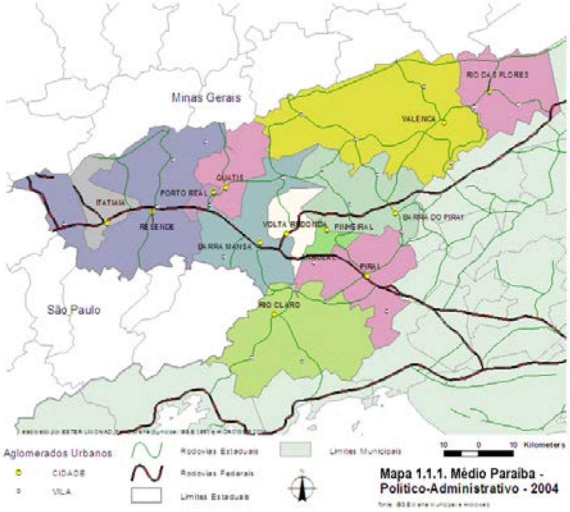

Fig. 1: CODIN

The Medium Paraiba occupies an area of 6.203,5 km2 equivalent to 14,1% of the state, where 785.192 inhabitants live (IBGE, 2000), which corresponds to 5,46 % of the Fluminense population. It's the most populous region of the interior of the State of Rio de Janeiro, with 22,3% of the country side population, evidently considering the historical concentration in the metropolitan zone of Rio de Janeiro, that answers for 74,42% of the state population. It highlights an intense mobility of the workers among the several places in the Medium Paraiba Valley, mostly to the cities of Volta Redonda, Barra Mansa and Resende, its main industrial zones. The region is in an area of demographic appeal because of:

- Old and recent process of industrialization of some cities (Volta Redonda, Barra Mansa, Resende, Itatiaia, Barra do Pirai, Piraí, Porto Real and Valença);
- Growth of the trading and providing of service (in all cities, except Pinheiral, Quatis, Rio das Flores and Rio Claro); and,
- Development of activities of summer tourism (Resende and Itatiaia).

3 Brief revision of literature

Well-informed of the strategic locale (according to the map bellow – figure 2), the city of Volta Redonda is one of the 83 of all country with more than 200.000 inhabitants, which, according to TSE (data of 2012) enables it to have a runoff in the elections to choose the mayor, as it actually occurred on the last October 28. Except capitals and cities from metropolitan regions, Volta Redonda is one of the few countryside cities in this condition. Another interesting data is about the economic factor, because the budget foreseen for 2013 is 1 billion reais, which once more puts this one city in a restricted list of the billionaire cities. Other relevant characteristics that reinforce the option of our study object relate to the gradual, but constant, change in the profile of an eminently industrial city, to a bigger diversification with the enhancing of the service section.

It happens that with the coexistence of the population with the CSN is not yet peaceful when talking about environment, for example. The enterprise responds to lawsuits from the Public Ministry both state and federal, for, as an example, burring toxic residues where nowadays there's a whole neighborhood (Volta Grande IV) built; another one is the pollution of the River Paraíba do Sul, which supplies Fluminense lowlands and the metropolitan zone, being monitored by the Executive Committee of Integrated Studies of the Watershed of the River Paraíba do Sul - CEIVAP (Federal Decree nº 87.561/82), being revitalized, after, with the approval of the Federal Law nº 9.433/1997, from the National Policy of Hydric Resources.

Fig. 2: CODIN

4 Methods

The methodological approach to be developed in the action will be the stimulation of the democratic debate via University TV based on Habermas' Theory of Communicative Action, and on the dialectical method of interviewing illustrious residents of the city of Volta Redonda that experienced the period pre (and during) the privatization process of CSN, collating with interviews of young people born after that period, and how both use and deal with New Technology of Information and Communication (NTIC's), as well as ascertain their degree of awareness of the technics and procedures employed for the main source of funds of the locality, and the much impact that these bring to their own lives.

As a stage of the implantation of the University TV of Volta Redonda and propagation of programming, we'll need to interact with other high education institutions around, in the sense of inviting them to integrate a nonprofit association responsible for signing contract with the local cable TV operator, and all the logistical and operational management of the process.

A legal ease is that the University TV (UNITEVê) of the city of Niteroi (host of the headquarters of the Federal Fluminense University) already has the entire registry, because it is already operational. As we'll be a subsidiary of the UNITEVê, we'll have CNPJ – CadastroNacional de Pessoa Jurídica (corporate taxpayer registry), and we'll be able to demand the creation of the channel, from the local operator.

5 Results

Reinforcing the university role of bringing knowledge and information for the population, we've transcribed a patch of a recent decision from the highest court of the country, the STF – Supremo Tribunal Federal (Supreme Court), where the minister Ayres Britto thus spoke about the right to information and the right to freedom of speech, "are part of the list of individual rights of constitutional matrix, taken as a direct emanation of the principle of human dignity and citizenship". In his vote, in the same action, the Minister Gilmar Mendes thus spoke:

> *"Here, it seems to me that we are facing rights that have – such as freedom of speech – both democratic and functional dimension. Those are basic rights of the own democratic system, the running of the own system; they're individual rights, but are also organically institutional rights; they set a dimension, even participative..."*

In the same line of reasoning voted Minister Celso de Mello: "(...) freedom of speech doesn't assume absoluteness in our legal system, considered, under such perspective, the clauses inscribed not only in our Constitution but also in the American Convention on Human Rights".

One of the challenges of the present action is having the Federal Public Universities Administration observing that the occupation of the University TV channels is a powerful tool of democratization of public communication in Brazil; and inserting the theme in the government agenda, for beyond the merely Manichean discussion between "right-wing" or "left-wing" thesis about the function of the media as agents of domination and/or empowerment of people, according to the words of the journalist Eugênio Bucci:

> *"(...) the discussion in the country has been hampered for two irrationalities: one is from a right-wing matrix, that says that no regulation is needed; the other, from a left-wing matrix, that defends the regulation for a desire to censor media. For Bucci, the regulation is necessary, especially to face three bottlenecks: the disagreement among religion, media and political parties; the possible presence of monopolies and oligopolies, and the abuse of funds devoted to official advertising."*

According to the former minister of culture João Luiz Silva Ferreira, the quality of Brazilian TV is very low and it would be necessary to contribute with the elevation of its standard, with more qualified content in its programming. It's known about the importance that the mass media have assumed in current daily life. Once these instruments are capable of forming opinion, it’s necessary to give options to the general public, capable of generating a critical opinion. It’s extremely important to fomentactions that aim, precisely – through what is the vanguard of the creation of knowledge in our country, the Universities – to enrich, valorize and create a critical opinion in the academic public and in general citizens.

6 Conclusions and recommendations

It was found in the polls the availability of a local academic TV, interacting students with the practice of the market and class theory.

Technical visit to the cable TV operator has found the need of installation of 3 km of optic fiber, interconnecting the UFF campus. Equipment and necessary installations to the proper operation of the TV are in process of acquisition, being already finalized and ratified the electronic proclamation (*“pregão”)* n° 111/2012, beingin the phase of settlement and opening of effort to the winning enterprises. The potential public is about 16.000 houses.

The referred action attends to the relation between extension and academic research, because it's expected for the knowledge discussed in the educational environment, often restricted to the classrooms, to be able to bring to the population not just a new possibility of access to information and thereafter a larger knowledge about their rights while citizens, opening for the chance to fight for their own interests and the communities’, but also puts itself as an alternative in the field of Brazilian public communication. This action already awakens the curiosity among students and local community, affirmed by the discussion raised with the results.

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Stimulating The Creativity Of The Team And Encouraging Entrepreneurial Attitudes In Academic Environment: How To Deal With The Innovation?

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Abstract
In this paper we try to investigate the most essential conditions set of the innovation-friendly environment. Our aim is to find the culture of work, in which participants are well motivated to experiment, and not afraid of being entrepreneurial. After new experiences gained in the leading in the innovations environment of Silicon Valley, we suggest new approaches towards innovation with the use of 'adopt and adapt' rule.

We consider perception of failure from the cultural point of view and diversity of people engaged in the projects – interdisciplinary teams as the innovations nests. We try to work out the methods of handling new technologies (e.g. disruptive innovations) and introduce open innovation model for empowering collaboration with industry or with other universities. In order to support the presented ideas we attach several case studies of success stories.

The outcome of this paper is newly developed set of recommendations and approaches, which could be helpful in stimulating the creativity spirit and entrepreneurial attitudes among the universities' crews.

The proposals have been worked out during the intensive program 'Top 500 Innovators' which focused on the science management and commercialization. These are the results of many discussions and meetings with CEOs of leading companies from Silicon Valley, professors of UC Berkeley, directors of Technology Transfer Offices (UC Berkeley, LBNL, LLNL and Stanford OTL) as well as personal experiences of managing the start-ups.

Keywords
Creativity, team building, innovation, failure, entrepreneurship, start-up, working environment, culture of work, Silicon Valley.

1 Introduction

Introducing new approach of management in any area of activity is a complex issue and demands following a set of baby-steps until succeed. There is always a bunch of mutual connections among many different elements of a strategy. Because of that we have to consider not only single change, but also parallel improvements in different domains, which are correlated. In this paper we propose analyzing physical and organizational conditions of work, we look at the environment of Silicon Valley and try to identify advantages of it and adopt some of them to our conditions (second section). Ability of group work and desired features of the team members, as well as definition of *T-shaped* people are discussed in third section. Complementary to issues mentioned above we describe new approach - appropriate perception of failure and incentives for experiments described in fourth section. It is essential to define scope of term innovation and broaden view of that subject (fifth section). In order to provide easy flow and exchange of ideas, methodologies or technologies, the classical way of thinking has to be changed. Because of that we introduce new model of open innovation (sixth section). In the last section we point out the main risks connected with disruptive innovation, and present methods for managing them. We conclude paper with important remark - business and market are very dynamic and one must be flexible and ready to pivot all the time.

2 Microclimate of Silicon Valley

Specific atmosphere of the Silicon Valley is conductive to dynamic development of new technologies. It happens due to a few main factors, which, thanks to geographical closeness to each other, create synergy effect enhanced their influence. First of all - Silicon Valley is a cultural, industrial, ethnical, religious and social diversity. Such conditions allow breaking schemes, stereotypes and national or opinion barriers. Monocultural team will never be as much creative and efficient as multicultural one.

Another very important element of this environment is so called '*supply chain'*. There is very small physical distance between the suppliers, developers, and producers- almost all of the stakeholders. Moreover, we have access to specialists and technologies from different areas as well as financial and consulting institutions. This is what makes this region so special. Similar clusters are known in other parts of the world e.g. film industry in Hollywood or manufacturing in China.

We cannot recreate all of the features of Silicon Valley in our work environment, but we can introduce good patterns and practises. For sure we have to be more open for internationalisation and diversification of project teams what will increase creativity and efficiency of our actions.

Henry Chesbrough said to me during one of our meetings: *To move wisdom you have to move people*.

3 What means to be T-shaped?

Conception of splitting people in two general categories – *I-shaped* and *T-shaped* is based on their skills and abilities gained in importance during last years. It has appeared already in 1991 and was some kind of variation on the *man of the renaissance* as described in Guest (1991). It happened due to changes in perception of work and those who carry out the work as stated in Career Life Connection (2012). People representing the *I-shape* type have thorough knowledge and experience in individual field. They are experts in what they do, however they lack soft skills or understanding in other fields.

Character *T* became the symbol illustrating two main sets of man qualifications. Following the ERE.Net (2010), Tim Brown (CEO of IDEO) defined such people in that way: *the vertical shaft of the T represents the depth of expertise/skill that a person exhibits, while the crossbar of the T represents the amount they are willing and able to collaborate*. He believed, that while building team consisted of *T-shaped* people one could achieve interdisciplinary crew, which will be extraordinary creative and able to cooperate efficiently. Other approach clarifies that horizontal shaft in *T* represents ability to understand many fields and the vertical one corresponds with deep and through wisdom in very narrow area.

How Jobs are Changing

	Traditionally	Today
What work is:	A Job	A Role
What work covers:	A Function (IT, sales, marketing, finance)	A Set of Tasks and Specialties (software development, writing, statistics, communications…)
What you do:	"Own" a function and manage it	"Contribute" in teams and get work done
How work is scoped:	Responsibility (Functional areas, span of control)	Project and Jobs to do (Ownership of tasks and projects as part of a team)
How work progresses:	Career Path (Increased upward mobility in a function, with greater span of control)	Career Progression (Increased responsibility and project experience, often horizontal)
How you develop:	Upward Mobility (to manager, director, VP)	Increased Specialization and Experience (to senior, expert, consultant)
How you are recognized:	By your level, title, span of control, size of office – by your boss	By results delivered, expertise, and demand for your skills – by your peers
Role of leadership:	To direct and manage, hold people accountable	To build teams, lead teams, contribute, inspire, empower and coach others
How you succeed:	Widen your skills and build more power in the organization	Deepen your skills, drive results, and get more done
Tools of the trade:	Job models, competency models, descriptions, organization charts, top down directives	Capability models, knowledge sharing tools, expertise directories, shared values and mission

Fig. 1: Change in a perception of job, ERE .Net (2010

All above do not indicate that one ought to build teams by selecting only *T-shaped* people. Bill Buxter (Microsoft Principal Investigator) once said the best team is *I-shaped* people completed with three *T-shaped*. Such a compilation provides appropriate level of expert's wisdom, enhanced by communication skills and tools for group work (identification and distribution of roles, motivation, using the potential of every team member), and by a variety of fields of interest, which increases the creativity of the crew.

4 Perception of failure

Perception of technology pioneers, whose companies went bankrupt, is in California significantly different from the well-known one in Europe. In the Silicon Valley they are treated as valuable source of the wisdom and c onsidered experts. For those reasons they are desired workers in the labour market of companies, which would like to run their business in similar or directly the same area. In European culture such people are labelled as “untrustworthy” and considered losers. The conclusion is simple - if they failed, they are not good enough. Nobody wants to collaborate with defeated. Are we encouraging to experiment, to look for new solutions and develop innovation by such perception? We should consider and introduce new approach: *sometimes it is OK to fail!* There is no progress without failure.

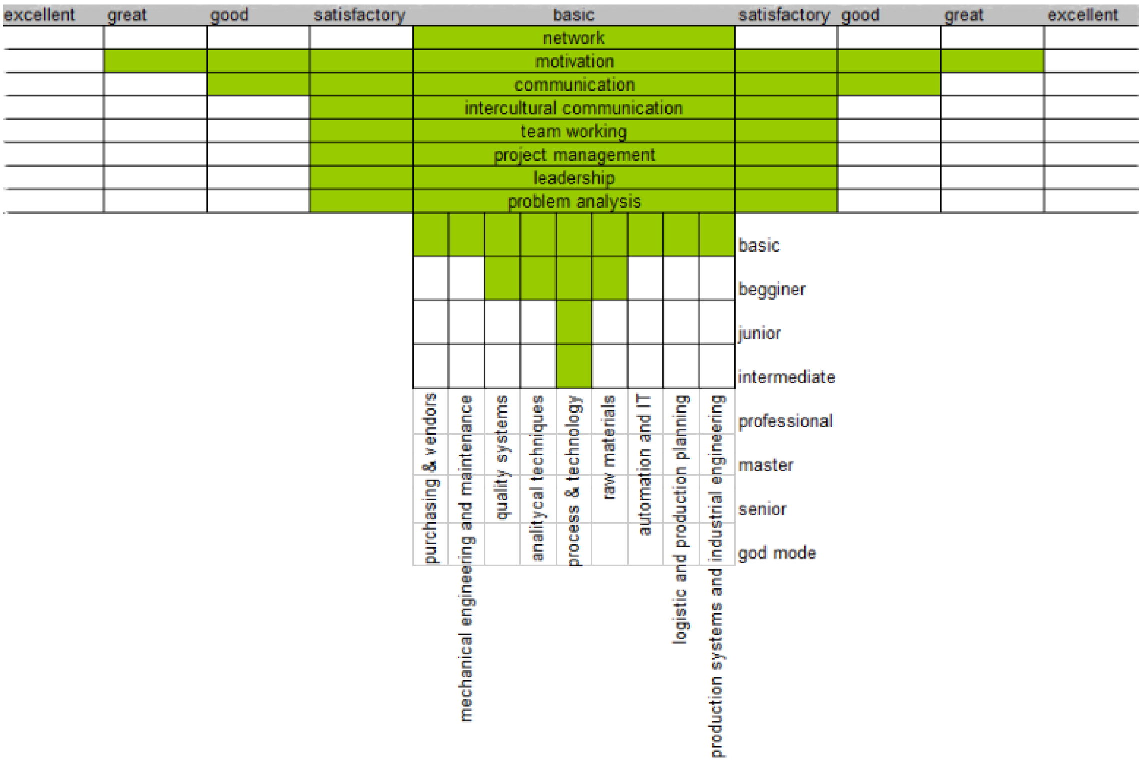

Fig.2: Building the shape on site, T-shaped professionals (2012)

Culture of work in particular organisation may stimulate creativity of its workers. It is crucial in dynamic, growth-oriented areas and in companies, which want to use innovative and unconventional approaches. In order to introduce innovatory way of thinking, one have to create appropriate conditions and organisation of work, in which such undertakings will be rewarded and supported, not rebuked and perceived as jump the gun.

There is no technological progress without failure and dead ends. Everyone, who looks at the history of technology a bit closer will easily notice that, if every scientists had stepped back and dropped their work after their fail trials we would still lived in the stone age. Ups and downs are hallmark of progress – learning by our experience and, what is more important – learning by experience of others and courage in recovering from them and taking the next step.

Necessary element of building the friendly environment for experimenting and using new tools and conceptions is depersonalization of fault and failure. One must not mentally burden the individual for their unsuccessful trails or incorrect approach. Such wrong assumptions should become source of new data and conclusions, which could be helpful by filling the arisen gap.

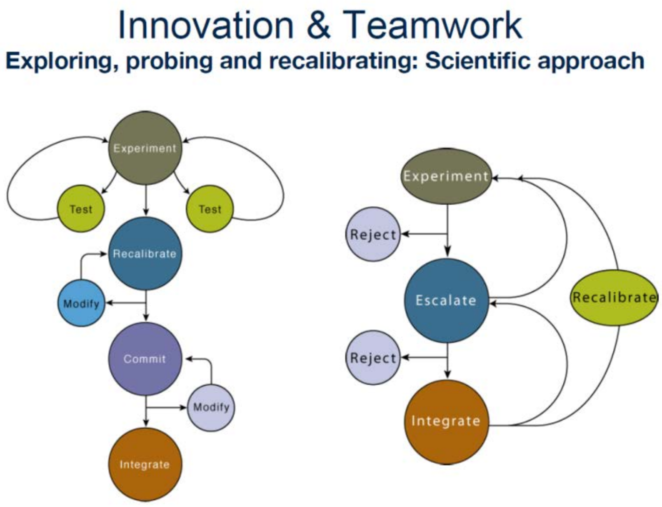

Fig.3: Cycle of developing the solution, Bahrami (2012)

I have not failed. I've just found 10.000 ways that won't work.

–Thomas A. Eddison

If you fell down yesterday, stand up today.

--H.G. Wells

If you've never failed – you haven't tried hard enough to succeed.

--Steve Jobs

5 What is the innovation?

We speak a lot about innovation these days. This catchall appears almost everywhere and in every context. It suits perfectly in many indicatives of European Union, particularly funding of various kind. But the troubles start when we ask someone what the *in-*

novation is. First thing coming to head- it is something new or based on new technology. This kind of conceptual wandering indicates that we are familiar with it, but not in details.

Let’s outline two essential issues. First of all- innovation does not have to involve new things (especially in technology). Secondly- innovation is not only about the creating something that has not yet been seen. Note the difference between words *inventor* and *innovator*. First of them discovers or invents new thing, technology, way of thinking, etc. The second one introduce new value (renew), its effect may apply to both old and new.

As it often happens new product brings new values and meets needs in a previously unknown way. Innovation occurs in many contexts and many various areas. It is not only valuable because of its tangible physical form, but also because of its sociological and business value. In simpler words - innovation could be a combination the existing elements, made to create a new value, or creation of ideas, so far absent, carrying some ideals.

6 Idea of the open innovation

Internal R&D departments of companies, encryption and hiding the data and source codes of software, patenting any results of scientific researches and emerging technical solutions have influenced on development of innovation. Legal and communicational restrictions caused that people often *reinvent the wheel*, spend lot money for researches already done by someone else, or carry out work in the wrong direction. Classical model of innovation (internal innovation) has run out these days.

Today it is very hard to develop new solutions or technology yourself. From the ergonomic point of view it is not efficient, because each depends on the time and financial effect. In this impasse comes to our rescue a new model of creating innovation - one based on free exchange of concepts and solutions among entrepreneurs, research institutions and authors. This approach helps to maximize efficiency of work, reduces cost and allows collective work on interesting topics (refers to idea of *open source* and *crowdsourcing*).

According to Chesbrough (2006), innovations developed in one company can be released into the market and be adapted by other enterpreneurs helping in creating new markets. They may also contribute to the company's current market. Flow of innovaions is regulated by internal policy of the companies, wherein in every moment particular solution can be enclosed and independly devenlopts. At this point it may be a conflict in the understanding of *open innovation*. One concept, derived from the MIT, represented by Eric von Hippel assumes the model should be completely open and be for public good, like an *open souece*. The second one, derrived from UC Berkeley and taught by

Henry Chesbrough, assumes combination of idea of openness with business model. In this way new financial flows could be created, as we can read in Chesbrough (2006).

7 Sustaining vs disruptive innovation

Have you ever wondered, how it happens that in our market, there are new devices that use previously unknown technologies? In fact the path from the invention (created in the laboratory) to the commercial product in the market is very long. How hard and time-consuming way must innovation pass, before it will be available for ordinary customer? Who decides at what stage, and if at all, it is worth to invest in it? Will there be a breakthrough? Companies which build their strategy of growth, want to be innovative and remain competitive in the very dynamic market, must answer these and many other questions.

Vast majority companies leading on the market are completely unprepared, when it comes to branding new technologies. Worldwide giants do not know how to cope with disruptive innovations. One of the reasons is using improper methods and conceptions for these specific products. It could be compared to repairing the watch by using hammer and chisel – we are bound to fail in advance. Why does it happen? We will try to explain this in a few sentences, which help to understand the specification of disruptive innovation and indicates differences between it and classical linear innovation (with witch mentioned companies handle very well).

At first existence of disruptive innovation does not seem to be interesting for companies leading in certain fields. This emerging technology has worse attributes in areas, which current market expects and actual solutions work there perfectly. In spite of that, it provides new previously absent attributes. Technically - it creates an opportunity to open new markets, but in evaluation, it is quite shallow and unknown (necessity of company's transformation and taking the risk). Large stabilized companies with wide scope of customers do not see significant source of revenues and sense of investment in new developed innovative products. It happens due to missing current customers' needs as we can read in Christensen (1997).

Disruptive innovation develops and improves itself much more quicker than currently used technology. It rapidly achieves, even exceeds, level of performance expected by the market. At this point, the additional values correlated with new technology, previously perceived as inessential, become significant advantage in competition with old solutions.

Strategy of the big companies should include: identifying new market for disruptive innovation, planning small revenues during developing it, and expositing new values of a product in a market. In order to avoid connecting this uncertain product with stabilized position and trademark of company, it should establish new independent mark under the wings of primary company. Source of feedback for this innovation has nothing to do with current customers, who got used to products that meet their needs perfectly. New set of people and companies, who will lead the evolution of product, must be found (market niche). They will appreciate new values of innovation, which help them to prosper.

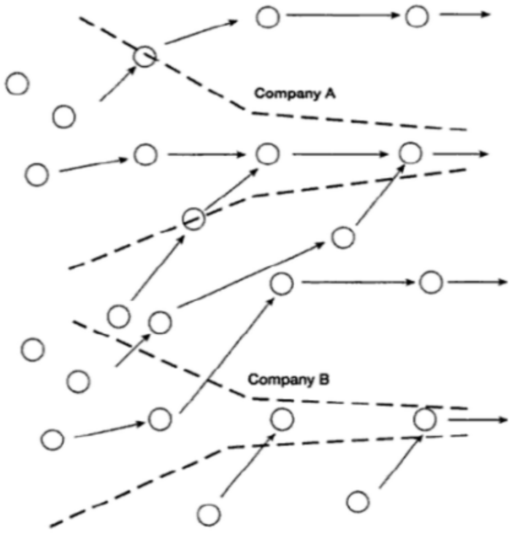

Fig. 4: Open Innovation: the new imperative for creating and profiting from technology, Chesbrough (2006)

Some big companies use the strategy called *second to invent*- it based on detailed observation of start-up, while it develops new technology. They do not interfere, but learn on its mistakes. When they gather sufficient amount of data and notice, and when market for that innovation emerges- they take over the pioneer firm or destroy it by entering the market as a competitor with a large capital.

Following Christensen (1997), every technology has got its limitation of devenlopment. It is described by so-called *S-curve* – it means there is a moment of twilght for every technology and one has to have prepare a new solution, which state of devenlopment will be at dynamic point.of another *S-curve*. We could say that every disruptive innovation will in time turn into sustainig innovation, and its devenlopment will gain incremental pace.

8 Conclusions

If we want to stay up-to-date in science or business, we have to analyse market and trends all the time. We could say that *trend is our friend;* it indicates we have to be ready for the pivot, prepared for reframing our strategy, or for changing direction of our activity. Only such approach gives us a chance to be a leader in a certain field, as we know noting is constant. Following the example of venture capitalists we should not be afraid of very risky undertakings and projects. There is a great chance of failure, but if we succeed – it is a huge possibility it will be a breakthrough. To facilitate such an approach we should establish some kind of internal fund in our institution – devoted only for venture projects.

In order to stimulate the creativity of a team we have to challenge them from time to time, maintaining their activity on a high level. It could be achieved by mixing the teams and rebuilding them, it also provides the flow of fresh members as well. We have to remember that none of a homogenous crew will be as efficient as a various one. It facilitates exchanging of ideas, knowledge and skills. Do not forget about soft skills, which are crucial during working in a group, where communication is one of the most important issues. Disability of using the strengths of all group members and lack of fluent communication is what makes the real group less efficient than potential group.

During development a new solution or project, we could spare a lot o time and funds by using the methodology of *minimum viable product*. It means, that we need to create a set o minimum-desired features of the product and test it (build the prototype). If it does not work out as we expected, we reframe the assumptions and start the process from the beginning (compare Fig.3). Introducing the change in any further stage of development of a product is much more harder and expensive. That best way is to spot any disadvantages in the first phase of production.

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How Industries With No Previous Collaboration With Research Centers Behave To Approach Them For The First Time? A Review

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Abstract

This paper explores the latest contributions in the University Industry Collaboration (UIC) literature on how industries behave when they have a technological related market problem, no record of previous relationships with university research centers and decide they need to approach them for the first time. What has been found is related to the reasons to justify the collaboration, what can be done to foster these relationships, how the collaboration has to be organized and which are the consequences of it. Among the papers found we would like to review how many and in what sense they talk about the proposed topic.

Keywords

Technology transfer, University Industry Collaboration, UIC, University Industry Relationship, UIR.

1 Introduction

Relationships between University and Industries have been studied since years. Bozeman (2000) mentions there is a “voluminous, multidisciplinary literature on technology transfer”. In this relative high amount of documentation, authors tend to give different names to concepts that could be assimilated as close-by or even identical. For instance, the name “firm” instead of “industry” is often used, or “collaboration” instead of “relationship” could be found in many papers.

Our method is to check what has been written in the last years and especially after the Bozeman (2000) revision mentioned before. The Databases such as EBSCO were deeply scrutinized through different questions: University Industry Relationship, University Industry Collaboration, How industry meets University, How Industry University, Industry meeting university and University Industry partnership. Reviewing the papers found and especially the interesting ones, it has been observed that some authors were repeatedly mentioned. So next step has been to find out why these authors were mentioned and extract from the database their main contribution papers. This is the case for the Bozeman (2000) or Etzkowitz (2000 and 2002). Adding to that some main laws have been found to have had an impact on the Academia Industry relationship and this is the case for instance of the Bayh-Dole Act (1980).

In order to leave things clearer and avoid controversies, Cambridge Academic Dictionary is used to find out the key words definitions this paper is going to be using all along. "Research" is defined as "a detailed study of a subject, especially in order to discover (new) information or reach a (new) understanding". "Research center" is "a place where research is performed". "University" is "a college or collection of colleges at which people study for a degree". As a comment in the case of the university, the mentioned definition shows a clear focus on academia. There is a common understanding by many authors that, besides academia, university objective should include research. "Industry is defined as "the companies and activities involved in the production of goods". Also as a comment, as per industry, the names "company" or "firm" are going to be considered equivalents for this paper. "Collaboration" is "the act of working together with other people or organizations to create or achieve something". "UIC" is the acronym of "University Industry Collaboration". In some cases, UIC becomes UIR, where "R" is "Relationship".

"Technology" has two main definitions. The first one is "The use of scientific knowledge or processes in business, industry, manufacturing". The second one is "New machinery and equipment that has been developed using scientific knowledge or processes". Sahal (1982) argues that the applied science as a "tool" is not to be separated to the "knowledge". Both are linked together. This means that the "tool" is transferred with its use and application. To simplify the concept, the "tool" comes with its "instructions" of "how to use".

Once the definitions are clear, the next question before exploring the literature is to have a look on the different points of view the UIC has been reviewed. Globally, the greatest number of publications on technology transfer has been published by management scholars. These can be organized in different technology topics to be transferred. The first one overlooks the production or design related technology or the "good" or service that is transferred (Lake, 1979; Teese, 1976). The second block mentions the relationship between the technology transfer and the company strategy (Laamanen and Autio, 1996; Lambe and Spekman, 1997). And the last one reviews the technology transfer within the same industry segment (Chiesa and Manzini, 1996; Rabino, 1989) or the impact of alliances in the technology transfer (Mowery, 1996).

It is also important to note that besides Universities and Industries, the governments, other administrative organizations and the surrounding society with its particular cultural behaviors play a significant role in the UICs. The policy paradigm, enforced acts and helps (grants or others) do also have an impact on the relationship. The models are going to be reviewed later on.

So the objective of this paper would be to check the available literature about the question of how industries with no previous collaboration with research centers behave to approach them for the first time.

To facilitate the understanding of the research, we decided to use the same block structure we found in the literature and so divide it into 4 major blocks, revising the finding within each block one after the other. These block are the reasons why of the UIC, how to foster the UIC, how to organize it and the consequences of the relationship, which altogether seems to follow a logical path for the establishment of a relationship.

2 Literature review

2.1 The reasons

Universities have traditionally had two basic missions: Academia and Research. However, more recently, some authors mention the fact that university objectives should also include the transfer of their research knowledge to the society (Etzkowitz, 2000; Kyoung-Joo Lee, 2010; Perkmann Markus, 2013). The argument is that strengthening the relationship between universities and industries can benefit not only the entities involved in the relationship but also the society as a whole (Bolton, 1994). In fact, some authors argue both are complementary (Kyoung-Joo Lee, 2010).

Despite the growing imperative for academics to bring in the academia research centers industry funds for research, much has been written on the commercialization of the research and the transfer of its technology. The topic of intellectual property, publication rights, the patents and their licensing is also emphasized (Berman, 2008; Perkmann, 2013).

Additionally, there are a number of publications mentioning problems, real or imagined (Bolton, 1994), barriers and boundaries to be overcome to make the relationship successful (Bauer, 2010; Sugandhavanija, 2010; David, 1982).

Perkmann et al. (2013) have recently published an article exploring the university engagement with firms and the commercialization one. Engagement is shown as being more the involvement in relationships with the industries and so might not conclude in any specific commercialization typical items such as patents or licensing. Also the reasons for one or the other are shown to be different and have different outputs.

2.2 The historical successes

There are a relevant number of publications showing successful UICs (David, 1982; Bolton, 1994; Turk, 2005; Wheatley, 2009; Bernardos, 2009; Kyoung-Joo Lee, 2010; Scott, 2013). However, it is also important to agree upon the method how to measure what success is or means. In order to assess how successful a UIC might be, Thune (2010) proposes four different approaches split in two groups. To start with, he approaches privileging the policy/program maker's "management-oriented" point of view. This brings in two sub-approaches: the program theory evaluation that assesses if the "system" or the "relationship" works within the preset parameters and the outcome analysis where the meeting of the objectives is stressed. As a second block of approaches, he incorporates a critical stance to the management point of view: the policy discourse analysis that differs from political level discourses and qualitative network analysis that stress the political and personal informal patterns and interactions.

Although the theory mentioned by Thune (2010) is very interesting, some authors directly propose recipes for success (Sugandhavanija, 2010). Others explain what kind of knowledge is more successful to be transmitted: splitting between tacit or explicit knowledge (M. Santoro, 2006). There are also publications showing which industrial sectors are more successful with UIC (Thune, 2010). These papers show that a significant majority of the UIC are linked to the Health-Bio and engineering sectors (Thune, 2010; Perkmann, 2013). Other authors demonstrate that big industries are not the only ones with high success rates in the UIC and some small industries have developed successful relationship with research centers. However Turk (2006) showed that the success factors for successful university industry relationships in big faculties are not to be copied to the smaller faculties.

In any case, Thune (2007) noted that nobody has studied the process of creation of the links necessary to start the relationship.

2.3 What universities and industries have obtained

Increased research costs make it more difficult for industries to be experts in all areas and access to university knowledge and expertise is considered to be an advantage (Ryan, 2008). Some studies argue that industries do not externalize directly sensitive technology, which they try to develop in house, but rather the non-sensitive or less strategic technologies. Other papers focus on what the industry has obtained such as access to unknown technologies or solutions to technological, industrial or organizational problems (Lee, 2000; Santoro, 2002; Rasmussen, 2006; D’Este, 2007; Koung-Joo Lee, 2010). In any case, some publications show that the industry culture is changing as a consequence of their relationship with universities (Varma, 2000). The implementation of stricter working norms such as the ISO or GMP, or that the work and studies have to be ethically well done, are partially a consequence of the scientific work behavior.

On the other hand, university culture is also influenced by their relationship with industry. Thanks to reaching agreements with the industry, the research center is able to pursue research in areas they would not be able to research without industries collaboration (Lee, 2000; Santoro, 2002; Kyoung-Joo Lee, 2010). However their behavior is also affected by the industry aim of reaching clear, practical and measurable objectives within a specified timeframe, which is something universities are not used to. Bolton (1994) has a look at some distorted ways to use the government grants via getting subsidies for industry internal research that does not profit the university. This is applicable to sensitive sectors such as defense, where grants just pass through the university without leaving anything really profitable or a way to keep the production plants running and avoiding massive layoff that could harm the local political interest.

Despite the fact Glenna (2007) said that there are few studies on industry evaluation of the UIC, it is shown in other papers that the relationship perception by the researchers is significantly more positive once they have collaborated with the industry than their perception of the collaboration before the collaboration.

3 How to foster the UIC

3.1 UIC models

In order to understand the UIC, some models have been proposed.

The Linear model is the most simplistic one and can be split in two basic ideas. Either the university has a technology and decides to sell it (supply push) or the industry has a technological related market need and goes to the university to solve it (demand pull). This linear model can be studied through history. Some authors propose historical structure evolutions:

First phase till WWII: As Etzkowitz (2000) mentions, state, academia and industry had globally little interaction (see Fig. 1).

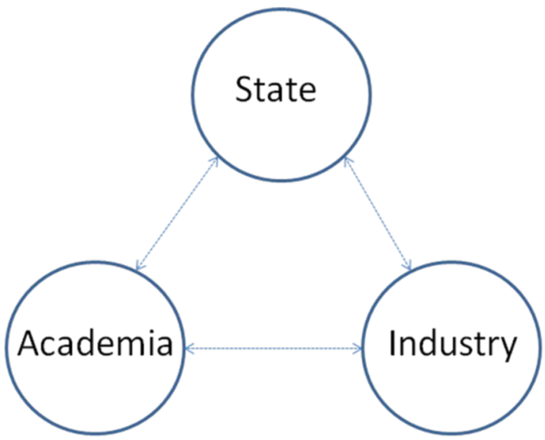

Fig 1: State, academia and industry "laissez-faire". Adapted from Etzkowitz (2000)

Second phase: The idea is that State had to provide a medium in which the industry and academia could collaborate. Etzkowitz (2000) describes it as seen in Figure 2.

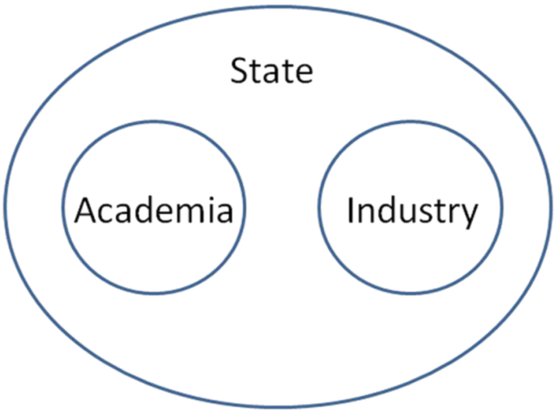

Fig 2: State actively interacts on both academia and industry. Adapted from Etzkowitz (2000)

In late 90s', the idea of the Triple Helix Model originated, originally formulated by Etzkowitz and Leydesdorff (1997), it describes the implication of a new social contract between higher education and society, which gives rise to a new interactive arrangement based on the operation of equivalent and overlapping institutional spheres with each group sharing responsibilities and with hybrid organizational structures emerging at the interface. See Figure 3.

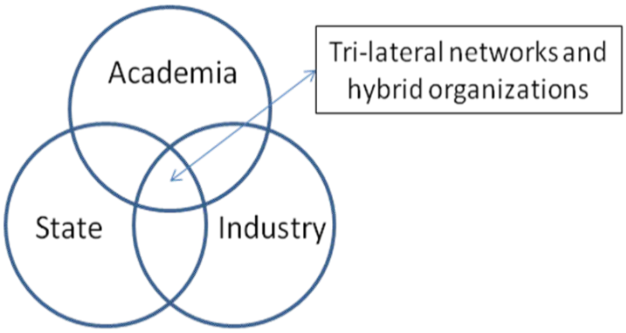

Fig. 3: The Triple Helix Model. Adapted from Etzkowitz (2000)

This successful model is used extensively worldwide to support innovative activities. As Etzkowitz and Leydesdorff (2000) mention, most countries and regions are presently using or trying to use this model in some sort.

However this is not the only valid model to explain the UIC. Bozeman in 2000 proposed the Contingent Effectiveness Model based on the idea of measuring the impact and effectiveness of the relationship between universities and industry. It considers five dimensions: the transfer agent, the transfer media, the transfer object, the transfer recipient and the demand environment (Figure 4).

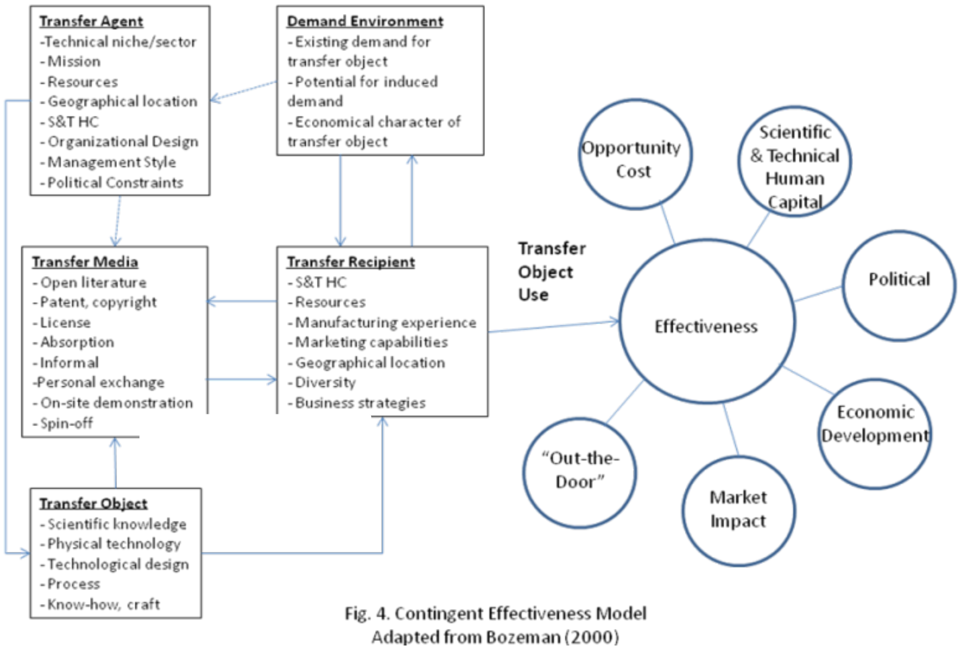

Fig. 4: Contingent effectiveness model. Adapted from Bozeman (2000)

3.2 Incentives

In order to foster the relationships between research centers and industry some authors analyze the incentives to be put in place.

For instance, Kitagawa (2008) examines the impact on venture business increase after de-regulations and subsidizing policies for R&D in Japan. Others, such as Manjarrés (2009), studied the way to balance the UIC promotion as a substitute of public funds to the research centers. Bauer (2010) proposed to avoid providing grants to Universities for technology transfer unless they do not commit to transmit the generated intellectual property to the industry.

3.3 Intermediaries

In relation to the technology transfer activities, many authors mention the importance that the intermediaries have on fostering collaborations (Kitagawa, 2008). Some models, putting upfront the importance of the stakeholders in their role in the TT are explained. Lane (1999) exposes the activities, events, stakeholders and resource providers that take place during the technology transfer (Figure 5).

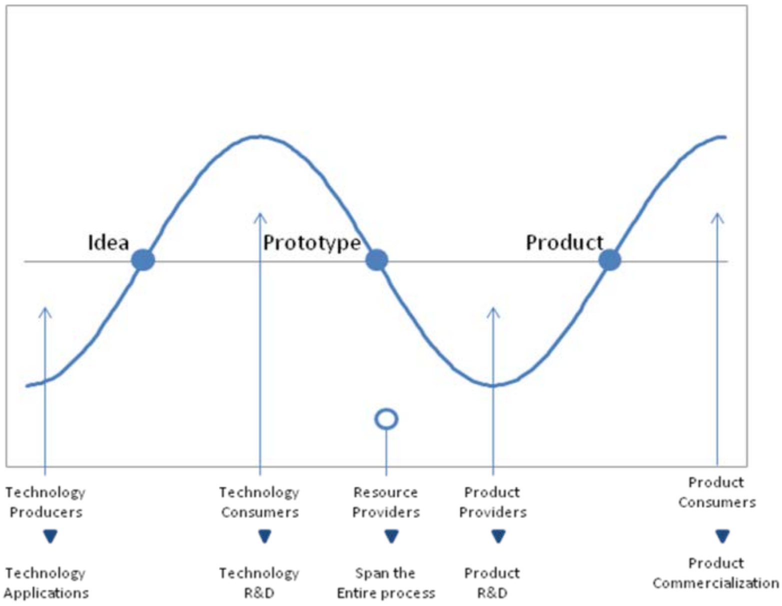

Fig. 5: Technology transfer model. Adapted from Lane (1999)

On the upper part of the figure 5, the model shows the consumer influence on the transfer while on the bottom part the technology is the one to basically influence the development.

Two topics recur in support of the UIC. On one hand, Bauer (2010) stresses the fact that the technology transfer has to be driven by the market need and the business interest instead of the more classical research + development + utilization model. On the other hand, authors also stress that the TTO and their liaison officers should not only be experts in intellectual property transfer, license and patenting but also request marketing and business expertise (Siegel, 2003; Malairaja, 2008).

3.4 Science parks, research parks, technopoles, innovations centers

The names can be different from country to country but the idea is the same: Science parks are a way to bring in together research centers and industries into a close medium expecting that they will collaborate. A geographic proximity between universities and industries is known to foster relationships and produce more knowledge (Jaffe 1989 - 1993, Audretsh 1996, Feldman 1999, Van Oort 2004, Ponds 2007). Using the same reasoning, the Japanese government de-centralized the R&D expecting that regional research centers would produce technology better adapted to the local industry needs (Kitagawa, 2008). Recently Saad (2005) proposed the science parks to be part of the Triple Helix Culture.

Science parks are seen as a place for linking University research centers and industries, to provide advice, infrastructure for the business relationships and image credibility to especially small businesses (Lowegren, 2001; Figure 6).

Type of resource	Description
University-related	University links, access to university resources, university education, academics and graduates as skilled manpower
Science park facilities	Business advisory services, venture capital, flexibility of premises, car parking, administrative facilities, science park management
Cluster effects	Image, reputation and credibility of location and collective learning

Fig. 6 Science park as a resource network; based on Lowegren (2001)

However there also some papers showing the limits of the science parks. Malairaja (2008) showed that, despite the science parks being set up to facilitate the commercialization of the developed technologies, there is no significant difference in collaboration between industries located within science parks and those located outside the parks.

3.5 The translators- facilitators

The translators or facilitators can be either an individual or a group, such as the Federal Laboratory Consortium Locator Service, to which an industry can submit their technology problem and get advice about which techologies might serve their needs (Bauer, 2010. The translator needs to be very flexible and have many fields of expertise (Tobbias, 1995; Lundvall, 2000; M. Luna, 2003). Other authors directly mention the kind of knowledge they need (M. Luna 2003, Santoro 2006): tacit and explicit, know-how, know-what and know-why.

The strong relationships between individuals, referred to as social connectedness, have shown to facilitate the knowledge flow (Santoro, 2006). However it is stressed that developing trust is basic, especially for tacit knowledge transfer (Santoro, 2006; Luna, 2003; Brannock, 2006). See Figure 7.

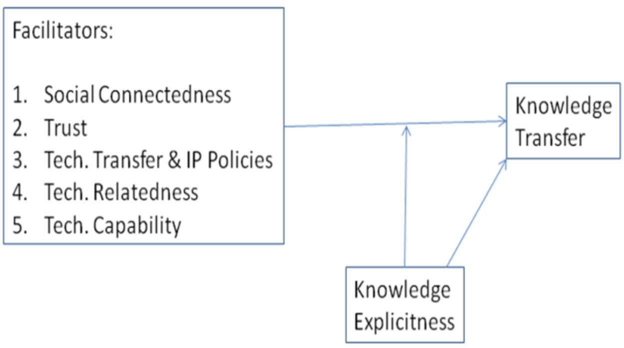

Fig. 7: Facilitators of knowledge transfer in UIC. Adapted from Santoro (2006)

3.6 The "what to dos" against U-I barriers

To begin some authors mention conflicts that can commonly arise during the relationship between the University research center and the industry. For instance a lack of understanding of each other’s needs, and insufficient rewards for scientists or the administration bureaucracy is mentioned (Messner, 1999; Siegel, 2003; M. Luna, 2003; Santoro, 2006).

As a solution, these same authors propose to develop networks strong enough to manage the expected conflicts. Others propose the use of “linkage” specialists (Berman, 2008; Weathley, 2009), or that the TTO officials, besides being patent, license and technical specialists, should have marketing skills and entrepreneurial experience (Siegel, 2003; Malairaja, 2008). Also, Malairaja (2008) proposes that the University officials visit the science park industries to explain the type of research being performed at the research centers and the available facilities at disposal for them. Last but not least, this opens the need for policy initiatives to remove constraints, such as excess bureaucracy, that impede the development of the UICs (Saad, 2005; Malairaja, 2008).

3.7 The success models

The American Industries’ relationship with academia in the 20th century has often been noted as an historical success (citation here). A prime example is MIT, which was founded to establish close ties between academia and industry.

For this, MIT started a program just after WWI involving more than 200 companies. For a fee, industries had access to state of the art academia and laboratories, staff and students who could solve a large variety of research problems. During the academic mobilization to win WWII, MIT developed multi-disciplinary centers and laboratories (G Omenn, 1982).

This multi-disciplinary body is been reproduced very. For example, the Working Education and Development Services (WLEDS) in Finland coordinated 6 education centers and related industries (Markkula, 2009). Other authors re-enforce this idea by showing that research-intensive universities are developing the cross-fertilization of disciplines by working in a single organization (Jones, 2010). Or the idea of a one—stop shop regional body for industries looking for access to academic researchers and advice over grant available funding (Wheatley, 2009). This is proven by some private owned research companies that have developed doing just this, for example the Irish IRIS (www.iris.cat) or LEiTAT (www.leitat.org).

In any case, some authors propose a list of factors to determine the relationship success and found out that success is a combination of more than just one factor. However, as mentioned before, social connectedness (Santoro, 2006), trust development (Santoro, 2006; Luna, 2003; Brannock, 2006) and clearing up topics that might go wrong early in the relationship (Brannock, 1998) are shown to be important. Failure is also determined by multiple factors (Bernardos, 2009) such as a technical problem, fund shortage, lack of definition and relationship problem.

3.8 Others

In general most of the literature is concentrated on research commercialization and technology transfer (Casey, 2005; Fulop, 2006; Kruss, 2006; Meagher, 2006; Severson, 2003; Thompson, 2003; Berman, 2008) and especially concerning Biology-Health and engineering sectors (Thune, 2010). Little research is found on industry perception of the relationship (Berman, 2008).

However industry people who really matter have a pretty good idea of the current research programs (Burringtion, 1993). This may explain why a majority of the university collaborations have been formed through the use of already existing contacts (Thune, 2007) and so shows the importance of social capital as a way to form collaborative ties. This also explains why there are different ways depending on the community and the context to negotiate science (Kleimman, 2003), why the R&D investment can be used for political reasons instead of innovation (David, 1982) or why legislation can be used to judge the university TT performance (Bauer, 2010).

4 How to organize the UIC

4.1 The Intellectual Property (IP) problem

4.1.1 Patents

Historically there has been an evolution in the treatment of the patent (Kitagawa, 2008). While the Wisconsin example in 1925 shows that prohibiting the University to patent has had important consequences that had to be reverted soon after its enforcement, the possibility to do so has brought funds to justify the UICs (Omenn, 1982). In fact, the reasoning is that industries will invest in innovation only if they expect to make attractive profits out of their exploitation (Jong, 2009). To do so, it is important to clear up that topic early in the relationship (Wheatley, 2009) and also to clear up the lag time for an industry to say “yes” or “no” to an innovation and file for a patent.

However, patents are not the only way to measure UIC relationships (D’Este, 2005; Cohen, 2002; Manjarrés, 2009). Researchers can still profit from their innovation by giving it for free. For instance, a study in the Nederland’s showed that 48% of the innovations were given at no fee to high tech Dutch SMEs and this proved to provide more profit to the whole society that a patent based agreement (Jong, 2009).

4.1.2 Licenses

Licensing, though it may bring more funds to the university, also requires skilled personnel to deal with. As these have a fix cost, independently of the number of licenses they have to deal with, it is likely that licensing profits more bigger collaborators than smaller ones (Turk, 2005).

On the other hand, licensing for innovations developed by the university, fails to account the greater impact of giving it for free (ratio 24:1) in the private sector and especially the benefit to the society and SMEs (Bauer, 2010).

4.2 The consortiums

Historically well-known consortia have led the consortium notion to have a clearly popular position within industry. It represents a low-cost, low-risk option for everybody, especially for the university because no industry has the leverage to exert strong influence on research directions (David, 1982).

However in order to be successful some rules and guidelines are proposed to run them (Lewis, 2001), it is especially stressed that user centric consortiums create win-win situations that yield the university real-life cases (Markkula, 2009).

4.3 The grants

The Bayh-Dole Act is mentioned several times as a success land mark for the UIC (Turk-Brint, 2005). It was created expecting the University innovation to flow easily to the industry, while generating more funds to the Universities (Glenna, 2007). Also, the Small Business Innovation Development Act describes how Fed Agencies should designate 2.5% of their budget to SME grants (Bauer, 2010) but often fail to find appropriate projects.

5 The consequences of the UIC

5.1 For the universities: Ethics vs. Money

A majority of studies show that UIC threatens research integrity and may limit the free exchange of information (Glaser, 2005; Florida, 1999; Manjarrés, 2009). This may tarnish the institutional reputations (Lewis, 2001) or blur roles (Powell, 1998; Kleimman, 2001; Glenna, 2007).

Other factors have an ethical impact. For instance, developing UIC may undermine to distinct public-interest and private-interest research (Kleiman, krimsky, lacy, Mc Sherry, 2001; Powell, 1998; Glenna, 2007) or be too short term lead (Mowery, 2005; AFT, 2001). Political ideology might also play a role in influencing research (Glenna, 2007) and the industry funding creates an incentive to promote the positive and suppress the negative in order to keep on bringing in more funds (Lewis, 2001; Martin, 2000).

However most of the studies qualify the UIC relationships as positive (Landry, 1996; Gullbrandsen, 2005; Stephan, 2007; Calderini, 2004; Azoulay, 2006; Breschi, 2007; Van Looy, 2004; Godin, 2000; Manjarrés, 2009) because basically these relationships bring in more financial resources, impact positively on their scientific performance and have synergistic effects on both, provided the R&D accounts for a small part of the researcher funding (Manjarrés, 2009) and time dedication (Tuunaimen, 2009).

5.2 For the industries: Risk vs. Profit

There is a general consensus that fed technology labs and university have only modest potential for creating new jobs and business on their own (Bozeman, 2000). That is why the industry is needed to bring in the market requests.

However, industry representatives overwhelmingly support UIR (Glenna, 2007). It is stressed that the research outsourcing is mainly used at strengthening their in-house technological capabilities (Kitagawa, 2008) and to avoid the "tunnel – vision syndrome", identified as the fact that the internal technological expertise prevents from indentifying potential technologies (Kyoung-Joo Lee, 2010).

5.3 The act consequences: The Bayh-Dole example

The basics aims of the Act were to let the universities protect their IP and to facilitate the transfer of technologies from public to private sector (Glenna, 2007; Slaughter, 2004).

This maligns any university research that does not translate into IP (Glenna, 2007; Somers, 2005). However there is no argument of shifting the university research priorities after the act enforcement (Cote, 1993; Turk, 2005). But findings show that the number of collaborations and the amount of funds have benefited the top ones and not the mid or low ones (Turk, 2005). The percentage of private funds was 2.6% in 1970 and increased to 6.9% by 1990 (Cohen, 1993; Bozeman, 2000) but this has been linked to the decline in government funding. Other papers show that the Act itself has not changed the basic trends in patenting. There is no structural break after its enforcement (Mowery, 2005).

Copying the Bayh-Dole legislation in other countries (such as Spain, Ireland or Austria) could be counterproductive because it focuses on licensing as primary channel and this can have chilling effect on other ones (Mowery, 2005).

6 Conclusions and recommendations

In this literature revision some basic topics have been reviewed. To start with some definitions have been settled down so as everyone understands the specific topics the literature is talking about. Most of the literature that has been found has been published by management scholars who can be organized in different ways. However in this paper the basics topics have been the reasons behind UICs, how to foster them, how to organize them and their consequences.

Looking at the reasons why, the increased pressure on academia to transfer its knowledge to the private sector has been stressed. This is supported by historical successes and the exposure of what universities and industries have obtained. On the topic of how to foster the UIC, different models have been exposed to understand the complexity of the relationship, the different incentives to be put in place, the importance of the intermediaries, translators- facilitators and the experiences with science parks.

In the how to foster the UIC part, the patents, licenses, grants and consortiums organization is reviewed. The consequences of the UIC show the fight between ethics and money in the academia and the risk vs. profit in the industry. Especial emphasis is put the Bayh-Dole Act and its consequences.

However, despite the idea that the research should be directed by market demand needs (Bauer, 2010), much of the literature on UIC has concentrated on research commercialization and technology transfer (Casey, 2005; Fulop, 2006; Kruss, 2006; Meagher, 2006; Severson, 2003; Thompson, 2003; Berman, 2008). Little is been researched on industry perception of the research links with universities (Berman, 2008).

This literature background is important to show that little has been found to explain how industries behave for the first time when they decide to approach a research center. In fact, only the mention that a facilitator can be a way (Weathley, 2009) or that a majority of collaborations have been formed through the use of previous contacts (Thune, 2007) has been found.

As a consequence, it seems there is no answer to know what industries do to find out "*Who has what to solve a technological market related problem and how I reach him for the first time*".

That is why it could be interesting to study how industries with a technological market related problem and no record of UICs, once they have decided they need a university research center, behave to approach them for the first time.

The contribution of this research would be to provide the insights of the procedures used and the way to perform this contact. By understanding the behavior (reasons why), a theory might be proposed for the reasoning behind it (how and why). The conclusions of a quantitative study might even help adapt the developed instruments to foster the UIC, especially among the ones that do not use it.

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Innovative University-Industry Partnerships: Comparative Analysis And Competitive Impact On The Palestinian Private Sector

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Abstract
Impact assessment is a concept often employed in the academic literature, but rarely explained, more so from partnerships' perspective aimed at developing economic growth and regional competitiveness. Through a combined survey and desk research methodology, this paper examines some preliminary analysis of findings of two studies: 1) a collection of initiatives currently running (or recently completed) in various Palestinian institutional sectors including the private, academic, governmental and NGO sectors; 2) a synthesis of studies that focus on an assessment of these initiatives. Based on the analysis, a framework for assessing impact in terms of a successive series of results is developed; its primary purpose is to review and assess initiatives in the Palestinian context.

Keywords
Impact assessment, innovative initiatives, multilateral stakeholders, emerging economies, private sector.

1 Introduction

Developing countries around the world are facing increasingly fierce competition from both regional and global markets. Palestine is no exception in this regard. In fact, challenges facing the Palestinian economy are compounded by a number of factors that include a legacy of prolonged occupation, high transaction costs due to restrictive policy measures imposed by the Israeli authorities, a weak productive base, and limited supportive role of government. A key potential driving force of the Palestinian economy is its industry, which consists mainly of small enterprises. These firms are facing immense difficulties. Aside from fragmented market demand that reflects an economy that is largely nascent, one such difficulty relates to the chronic mismatch between what universities are providing in terms of its graduates' skills and specializations, and the needs of Palestinian industry. Bilateral and tripartite (public sector - private sector – university) partnerships have emerged as key forces in promoting economic growth and competitiveness in emerging economic regions in other parts of the world are only beginning to make their emergence in Palestine. Various forms of interaction have appeared amongst the various players. Large inter-governmental organizations (IGOs) such as the International Monetary Fund and the World Bank typically mobilize heavily around non-governmental organizations (NGOs). No doubt, this effort has produced tangible outcomes, although long-term, bottom-line impact of the interactions between these two bodies in the specific Palestinian context remains to be established definitively (Kelly, 2011; Lopes, 2011). Private sector players in Palestine have been no less active. Indeed some very recent initiatives built around a partnering between PADICO Holding, a successful Palestinian investment and development corporation, several Palestinian universities and NGOs towards training and developing young university graduates (Dawoudi et al, 2013) is a good example of the partnering effort that has been built around strategic networking and exchange of knowledge. Initiatives of this sort, while representing effort that is very much work-in-progress, demonstrate the immense potential that focused partnering effort between the various players have for enhancing competitiveness and economic development in the region.

Indeed, over the past decade the amount of effort invested in development aid targeting the growth of the Palestinian economy has grown significantly. Institutional sectors that include the private sector, governmental bodies, universities, and non-governmental organizations (NGOs) are the active players. The organizations represented by these various sectors range from commercial enterprises to organizations such as the NGO Development Center (NDC), an innovative Palestinian non-profit organization that seeks to promote the effectiveness of NGOs operating in Palestine through the mobilization and channeling of donor funding in the form of direct grants and capacity building programs. Private sector players such as PADICO Holding, a limited public shareholding company traded on the Palestine Exchange are investing in the development of the Palestinian economy through investments in fundamental training programs that seek to build those skills in young graduates that they perceive to be missing when hiring these for positions in their own enterprises.

The increased activity in initiatives funding notwithstanding, there has been a growing concern amongst both donor and recipient institutions about the way in which the results of the funded effort is being evaluated. Amongst other things, this has resulted in a greater focus on the monitoring and evaluation of the activities and outcomes of NGOs. The most notable development, arguably, has been a clear shift from the 1980s when the efforts of NGOs went largely unmonitored (on the assumption that the efforts of NGOs would have an impact by virtue of who they were and their proximity to the beneficiaries) to effort that has aimed at prescriptive and normative approaches to the measurement of impact in the 1990s (Adams, 2001; Roche, 1999; Bird, 2002). Since then there has been a further shift toward more analytical and critical approaches to the assessment of impact (Davies, 2001). Indeed, developments in recent years have included participatory approaches to monitoring and assessment of impact, and efforts directed at developing approaches for assessing impact beyond individual projects, across sectors and even at a country program level. Alongside these developments, there has been growing recognition of the need for assessing impact emerging from bilateral and multilateral efforts involving the private sector, government and academia.

2 Impact assessment and analysis

Impact analysis and measurement is essentially about the assessment of organizational performance, whereby the ‘organization’ might, in fact, consist of a consortium of players that have joined in a collective effort. Measures that allow an assessment of an organization’s activities – whether this organization is a donor of funding or a recipient of the same – enable insight into the performance of that organization, and factors that drive that performance. Ultimately, this insight provides some indication of the degree of success of that organization in alleviating or resolving the problem or challenge at stake. The Universalia - IDRC (CIDA, Canadian International Development Research Centre) framework (Figure 1) presents the big-picture context within which the problem or challenge at the core of the initiative (which is aimed at its alleviation or resolution) presents itself.

The problem or challenge at the core of the initiative, while originating in the external environment, ultimately draws on the wherewithal of the organization (or possibly organizations and institutions that collaborate) in question. The impact of the initiative in questions is reflected by the success of the organization (or institutions) involved in its resolution. The analysis and assessment of that impact, particularly in the case of initiatives aimed at promoting economic growth and regional competitiveness, remains a contentious issue. One of the key issues concerns the definition of impact. The notion of impact introduces both temporal and metric variability that ranges from short-term/quantifiable to long-term/largely intangible forms of results that are difficult to quantify in any meaningful way. Another other issue concerns the variability in stakeholder expectations attached to the results of an initiative; whether short-term or long-term, whether quantifiable or not.

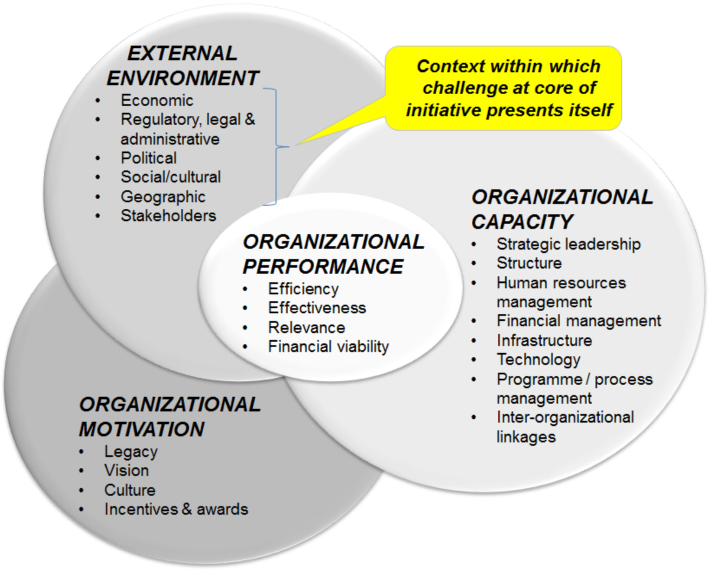

Figure 1. Based on Universalia – IDRC framework; showing 'big-picture' and challenge context perspectives (CIDA, 2006)

The objectives of the research reported on in this paper are several-fold. A first objective centres on a critical review of the current status of "impact analysis", specifically in the area of assessment of results emerging from funded initiatives effort. This includes the identification of unresolved issues and challenges related to this task. The focus is primarily at the unilateral, institutional sectorial level. A second objective of this research is the derivation and development of a suitable conceptual framework of impact analysis, specifically geared to the context of the emerging Palestinian economy. This framework is then to be applied in an assessment of on-going initiatives in field research conducted with various Palestinian institutional players – including the private sector, governmental, academic, and NGOs. The ultimate objective is then to channel the accumulated insights of the foregoing research towards building a better understanding of impact emerging from bilateral and multilateral (e.g. tripartite) initiatives.

Contributions of the proposed paper include:

(1) Review of impact analysis approaches and assessment methods and metrics relevant to development effort aimed at enhancing competitive performance (economic, societal, political) in emerging economies at the individual institutional sectorial (e.g. private sector, governmental, academic, NGO) level.

(2) Derivation of an appropriate conceptual framework for impact analysis and assessment for application in primary field research with various stakeholder groups (private sector, governmental, academic, and NGO).

3 Impact assessment and analysis

The analysis of impact falls within the area of performance measurement. *Impact*, in general terms, has defined as *"…a marked effect or influence."*[1] More specifically, in the context of funded initiatives such ones undertaken by NGOs, the term has been defined as "improvements in the lives and livelihoods of beneficiaries"[2]. More amenable to the notion of impact assessment is the definition by Blankenberg (1995):

'Impact concerns long-term and sustainable changes introduced by a given intervention in the lives of beneficiaries. Impact can be related either to the specific objectives of an intervention or to unanticipated changes caused by an intervention; such unanticipated changes may also occur in the lives of people not belonging to the beneficiary group. Impact can either be positive or negative, the latter being equally important to be aware of".

Key elements in Blankenberg's definition concern the element of change (ideally sustainable); the fact that this change may even be unanticipated, and the fact that the change may also be negative – at least to some stakeholders.

The assessment of impact, while not new in areas relating to the ecological environment and social context, is relatively new in the developmental field. Fowler (1997) proposes three levels of assessment: (1) outputs, (2) outcomes, and (3) impact. *Outputs* provide a measure of effort, in terms of the implementation of activities. *Outcomes* provide a measure of effectiveness, most often against immediate objectives defined at the outset of an initiative. *Impact* relates to the ultimate change; that is, the difference achieved in relation to the original problem situation.

The problems encountered with the three categories proposed by Fowler center mainly on the *measurability* of the three categories. While immediate outputs of an initiative are typically quantifiable, outcomes and impact are increasingly difficult to assess. This still raises the question concerning the relevance of the output measures to the greater problem at the root of the challenge that prompted the initiative in the first place. An OECD/DAC study on impact assessment conducted by Kruse et al (1997) pointed to deficiencies stemming from reliable evidence and a lack of data and suitable evaluation methodologies. Issues specifically related to the reliability of data used in the assessment of impact include (Adams, 2001; Cohen and Manion, 1989).

[1] http://oxforddictionaries.com/definition/english/impact

[2] OECD / DAC: Development Assistance Committee (of the OECD)

Dimension	Issue at stake
Face validity	• Are parameters we *think* we are measuring actually being measured?
Bias	• Is there distortion of the data in any one direction?
Convergent validity	• Do results from different methods support each other?
Internal validity	• Are the results accurate for the immediate case in question?
External validity	• Are the results applicable to cases beyond the immediate case?

Table 1. Issues related to the reliability of data used in assessment of impact

This still leaves open the question regarding the nature of the impact being measured. Indeed, some measures of impact, particularly those of long-term effect, may only present themselves in a highly qualitative form. Maxwell (1992) points to the importance of ability to interpret, and the nature of the insights to be derived from the interpretation in these cases. Between short-term measurable impact and long-term effects that are not readily 'measurable' validity of the assessment, validity of assessment derives from its inherent quality in terms of its inherent 'information-richness' – and the ability of the researcher to analyze this data (Patton, 1990).

Systematic approaches to the assessment of impact are a relatively recent development. CIDA's 'Results-based Management' were first introduced in 1996 and in a revised form in 2008 (CIDA, 2008). The approach incorporates three key elements: a logic model, performance measurement framework, and risk register. The aims of CIDA's 'Results-Based Management' (RBM) approach summarized as (CIDA, 2012):

- defining realistic expected results based on appropriate analysis;
- clearly identifying program beneficiaries and designing programs to meet their needs;
- monitoring progress towards results and resources consumed with the use of appropriate indicators;
- identifying and managing risk while bearing in mind the expected results and necessary resources;
- increasing knowledge by learning lessons and integrating them into decisions; and
- reporting on the results achieved and resources involved.

A key component of the RBM, the 'logic model' introduces several important elements that contribute to an improved understanding of the 'impact' resulting from an initiative. First, it identifies a cascading hierarchy in the chain of results emerging from effort invested in an initiative. Second, it maps the causal logic of impact. The model suggests six levels in the results chain:

- inputs
- activities

› outputs

› short- and mid-term outcomes

› ultimate outcomes (impact)

While inputs, activities and outputs define the ‘how’ of a funding investment, the three levels of outcome constitutes the actual changes – the impact brought about by the funded initiative. Short-term outcome is defined as an immediate result attributable to the initiative in question, typically at the level of an increase in awareness/skills of the beneficiaries, possibly increased access to some desirable resource. Medium-term or intermediate outcomes are defined as change that is expected to occur logically once one or more short-term outcomes have been achieved. Temporally, these are medium-term results that mark a change of behavior or change of practice level among the beneficiaries. The highest-level result is defined as the ‘impact’ level; it is the highest level of change that can be attributed to an initiative – typically indicated by a fundamental and sustainable change in the beneficiaries’ lives. From a donor’s perspective, the impact level represents the raison d'être of an organization or coalition of institutions collaborating on the resolution of a challenge.

The ‘logic model’ of the CIDA/RBM provides the conceptual basis for the cascading impact chain developed and applied in the research reported on in this paper.

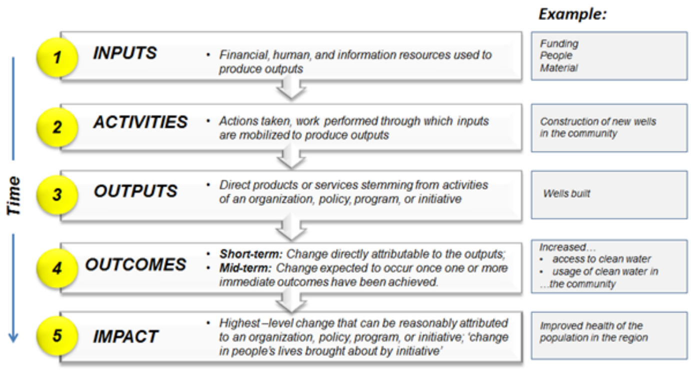

Figure 2. Impact cascade or chain model and illustrative example (based on CIDA ‘Logic Model’; CIDA, 2008)

4 Research questions

The purpose of this research is to build a better understanding of how the assessment of initiatives impact, specifically in the Palestinian context, is being approached, what the issues are – and how these are viewed by the various stakeholder institutions, whether donor or recipient. This research is currently yet at the ‘work-in-progress’ stage, hence a description of the objectives will be presented and discussed in the present tense; for those activities yet to carried out, in the future tense. The following questions summarized in Table 2 probe perceptions of the various stakeholders – private sector, governmental, academic, or NGO sector – involved in the administration of funded initiatives:

Research question	*Rationale; this question probes…*
1. What are the 3 most critical issues from the perspective of the various sectorial institution (whether as recipient or provider of funding) concerning the assessment of impact of funded initiatives – and why?	-for differences, commonalities in perception of issues (both problems and opportunities) amongst the four institutional sectors
2. Regardless of whether donor or recipient of initiatives funding, what is the ultimate outcome (impact) sought – for example, what change is being targeted in political, economic, societal or technological (innovation) terms?	-for differences/commonalities in guiding principles, aspirations, vision of various stakeholder representatives with respect to ultimately objectives of involvement
3. At what level (of the impact cascade) is impact of initiatives currently being measured?	-current state of measurement level; position along impact cascade at which results ate being measured
4. How important is the ability to be measuring results at the various levels of the impact cascade?	-perceived importance attached by the various stakeholders to the different levels of results along the impact cascade
5. What measures of impact would the various sectorial representatives like to be measuring (and why), but cannot (for whatever reason)?	-perceptions of the various stakeholder parties with respect to gaps in their current ability to measure impact
6. If an individual sectorial representative were to have one expectation against any (or all) of the other three sectorial institutions, what would that be?	-potential sources of misunderstanding; differences in viewpoints of one stakeholder towards other stakeholders with respect to issues relating to the initiatives funding and impact

Table 2. Research questions and their rationale

5 Research design & preliminary findings

The research design consists of three stages:

(1) *Systematic review and screening of secondary sources for identification of current and recently completed funded initiatives in Palestine* (initiatives/programs - integrated template of secondary data): A first stage (still on-going) has focused on a systematic review of various secondary sources to determine on-going and recently completed funded initiatives of various stakeholder groups currently being run in Palestine. The focus of this research has been to identify the nature of the initiative, stakeholders involved (both donor and recipient), collaborating partners, and objectives. This research has yielded the identification of 63 initiatives to date. A preliminary review of these indicates assessment of impact at primarily the lower levels of the impact cascade (inputs, activities, outputs); a more detailed review is current in progress.

(2) *Systematic review and screening of secondary sources for identification of studies, reviews and assessment of Palestinian initiative programs* (competitiveness / data / statistics / other Related studies - integrated template of secondary data). The purpose of this secondary research is to establish the status of reviews, assessments and studies that are focusing on the impact of funded initiatives in Palestine. This research has yielded 56 studies and reports to

date. These include reports of studies commissioned by all of the four stakeholder institutional sectors – private sector, governmental, academic and NGO. A detailed review of these for insight on what levels of impact are being assessed, indications of the success with which these are being measured, and the nature of the dissemination of the findings is currently in progress.

(3) *Primary field research: Roundtable workshop scheduled for March 6th 2013*. A roundtable workshop with representatives of all four stakeholder groups (including both donors and recipients of funded initiatives) – private sector, governmental, academia, and NGOs has been scheduled to take place in Ramallah, Palestine on March 6th 2013. This workshop is being funded by both the British Council (Palestinian Territories) and PADICI Holding. The objectives of the roundtable workshop are to elicit views and perceptions of the four stakeholder groups in response to the six research questions posed in the previous section. A survey questionnaire has been designed for use in the workshop; questions are posed in various formats, including semi-structured –type closed questions and perceptions based on 5-point Likert-scale breakdown.

(4) *Qualitative field research* on the basis of in-depth semi-structured interviews with various donors and recipients of initiatives funding. This final stage will be used to validate findings emerging from the previous three research initiatives.

6 Summary and conclusions

The assessment of impact of investment effort in initiatives of a developmental type remains contentious. Only relatively recently has there been a concerted effort to introduce systematic and structured approaches to this task. A lot is at stake given the increasing amounts spent on promoting economic growth and competitiveness in emerging economies. Ultimately, appropriate assessment of impact provides a means of providing justification and accountability for the vast amounts of funding currently being administered by a range of institutions ranging from the private sector to governmental bodies. Importantly, appropriate means of assessing the impact of funded effort also provide a critical instrument for strategic decision-making by all parties involved, whether donor or recipient of funding. This research reported on represents work-in-progress; it focuses on the Palestinian context. This paper discusses a conceptual framework derived for assessing level of impact, and some preliminary findings that have emerged from a review of initiatives in Palestine and studies on initiatives undertaken.

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A Customer Relationship Management System To Support Academic/Enterprise Engagement

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Abstract
This paper describes some of the issues raised in developing and implementing a Customer Relationship Management (CRM) system to support engagement in a higher education institution (HEI). Engagement is increasingly part of the higher education mission and the contribution of universities to local and regional economic and social development remains an important, but difficult to evidence, metric for Higher Education Institutions. Building on the findings of a significant collaborative project aimed at developing a roadmap for partnership development between academic institutions and enterprise this paper explores the structures and processes to support and stimulate engagement.

External organisations report difficulty in developing interactions with HEIs. These difficulties range from lack of clarity in terms of contact points to lack of visibility of the benefits of engagement. In addition, HEIs tend to operate as a series of separate academic units with little emphasis on collating business intelligence and systems to support strategic decision making.

This initiative builds on the findings of the Roadmap for Employment-Academic Partnership (REAP) project through a structured process which develops a professional case management approach to interactions and a reporting mechanism which allows the collation of information on current and previous interactions with external organisations.

In developing the CRM system, the approach taken was to codify the various interaction activities and to place the interactions themselves at the centre of the knowledge acquisition base. The aim is to develop a system which will provide the HEI with a full overview of the current interactions at any point in time and which supports good practice through workflow development. This practitioner paper addresses some of the issues raised in developing a customer relationship management system to support informed collaboration in university-industry interactions.

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Keywords
Customer Relationship Management (CRM), Engagement, Higher Education.

1 Introduction

While it is widely agreed that enhanced collaboration between industry and academia is of benefit to both, structures and supports for engagement are difficult to find. In many higher education institutions engagement interactions occur separately and at the periphery and are not considered part of the core. Considering the motivation for institute-wide approaches to engagement and the findings from a Higher Education Authority (HEA) funded inter-institutional project, this paper traces the piloting of a CRM system to support engagement in one higher education institute in Ireland.

Cork Institute of Technology is a publicly funded higher education provider. It is the largest of the state’s network of thirteen Institutes of Technology. The Institute makes its own awards at undergraduate and taught Masters level, under Delegated Authority from Quality and Qualifications Ireland (QQI). The Institute is also empowered to make its own awards for a wide range of designated disciplines in Science, Engineering and Computing at research Masters level and at PhD level.

CIT currently has in the region of 15,000 registered students with approximately 2,000 new entries year on year. Of these, approximately 7,000 are registered full-time on third-level programmes, and the remaining part-time. Cork Institute of Technology’s chief feature is the diversity and complexity of all aspects of its operations. CIT’s education, research and training provision spans a wide variety of disciplines, from business and humanities through engineering and science to music, drama, art & design. Its offerings range from craft programmes and maritime education in collaboration with the Irish Naval Service to PhD research programmes leading to CIT awards. Within CIT as in all HEIs there is a wealth of world-class facilities, experience and expertise, but it is not always clear to companies, enterprises, individuals or communities how to access, interface with or indeed, add to, this knowledge.

Institution-wide approaches to engagement

In Ireland, the National Strategy for Higher Education (Department of Education and Skills, 2010) places significant emphasis on engagement with the wider society, along with teaching and research as a means by which higher education can contribute to addressing societal and economic challenges. While recognising that higher education institutions have been involved in a wide range of engagement activities, the national strategy document suggests that these activities have not always been coherent and co-ordinated or embedded in the core of higher education missions generally. Internationally, an OECD report “Higher education and regions: Globally Competitive, Locally Engaged”, (OECD 2007) explores the complex landscape within which higher education institutions play a role in their regions.

Goddard (2009) proposes a broad institutional approach:

> *Engagement has to be an institution wide commitment, not confined to individual academics or projects. It has to embrace teaching as well as research, students as well as academics, and the full range of support services. All universities need to develop strategies to guide their engagement with wider society, to manage themselves accordingly and to work with external partners to gauge their success. (Goddard 2009: 4)*

While engagement is often presented as a third mission of universities, encompassing the full range of external interactions with enterprises, individuals and communities, separate and distinct from the first two missions of teaching and research, it is only effective if it is closely interlinked with them. Vorley and Nelles (2008) describe the third mission as a 'thread that has the capacity to weave together teaching and research, while assuming a more economic and societal focus'. Viewed in this way, engagement is not separate from education and research, but rather a new lens through which to view teaching and learning and research activities. Goddard clearly articulates the dangers associated with disjointed approaches:

> *Insofar as external engagement is taking place, the academic heartland is protected by specialist units dealing with technology transfer and continuing education. However the external engagement agenda… requires institutional responses, co-ordination and transversal mechanisms. (Goddard 2005: 30).*

Burns (2005) regards the process of embedding the engagement mission as an opportunity for organisational learning. Vorley and Nelles (2008) stress that engagement between industry and academics in collaborative research and commercial experience can make a significant contribution to teaching and curriculum development and that the students themselves can become the bridge for the engagement through industry sponsored projects and cooperative placements.

2 Engagement in practice

Through the Department of Education and Skills' Strategic Innovation Fund (SIF) a number of initiatives aimed at advancing engagement through collaborative work within the higher education system were funded. The Roadmap for Employment Academic Partnerships (REAP) project was initiated to consider and to advance a broader range of potential engagement with external enterprises. The project, which was led by CIT, involved eight higher education institutions as partners. The REAP project team have developed an approach to underpin engagement activity involving the establishment of clear points of contact, matrices of expertise and an institution-wide professional approach to the flows of knowledge and interaction between higher education institutions and enterprises or communities. The intention is that the learning developed through the collaborative work of the REAP project can contribute to the development of a system-wide support structure for engagement in the Irish higher education system, which will facilitate changes in practices and internal business processes of institutions. The developing national and international landscape within which engagement is clearly valued will expedite the changes in culture and mindset needed. The need for institutional transformation was clearly recognised in the National Strategy for Higher Education:

Institutions need to be internally adaptive in order to be externally responsive, and strong engagement with the wider community will require:

- › *Strong institutional leadership;*
- › *Change in the culture and internal business processes of institutions; and*
- › *Recognition of the importance of engagement activities in resource allocations, in promotion criteria and in the metrics used to assess progress at institutional, regional and national level. (Department of Education and Skills, 2010: 78)*

Through exploration of existing relationships between Irish higher education institutions and external entities it is evident that the HEI tends to operate not as a single homogenous entity but as a series of separate and distinct units. The experience from the perspective of an external partner then, is not one of a single, seamless relationship but of many disparate and different relationships with different parts of the institution. A recent national survey of employers' views of Irish Higher Education outcomes identified the need for greater engagement and openness, with a particular emphasis on the need for a joined-up proactive approach by HEIs (McGann and Anderson 2012). Academic and research units can operate as separate and sometimes competing entities from the perspective of the external partner. One exploration of engagement interactions found that a HEI might be involved with an organisation for undergraduate internships or work placements, customised learning and continuing professional developments, funded research projects, guest lectureships, graduate recruitment, sponsorship and endowments simultaneously through a number of different academic departments and research units. Initial investigation found that there was no single view of this relationship extant within the HEI. Without a clear institutional view of the depth and breadth of engagement interactions, it is difficult to achieve any organisation learning or to develop potential strategies that might benefit from a more integrated response.

2.1 CRM in Higher Education

Responding to the findings of the REAP project and the need to restructure the institution to support engagement, CIT Extended Campus was established in 2011 to support and stimulate the full range of engagement interactions. The Extended Campus works to provide a platform for the transfer of knowledge in both directions and to enhance opportunities for engagement. In seeking therefore, to paraphrase Goddard, a 'transversal mechanism' to support a coordinated institutional response, Cork Institute of Technology sought a customer relationship management (CRM) solution to support and stimulate engagement. CRM is a model for storing an organisation's interactions with both internal and external entities in a single database. Customer relationship management (CRM) involves the deployment of strategies, processes, and technologies to strengthen relationships with customers throughout their life cycle (Nair *et al.* 2006). Although a large portion of a system such as this is technological, viewing CRM as a technology-only solution is likely to fail (Chen and Popovich 2003). While information technology assists with the re-design of a business process by facilitating changes to work practices and establishing innovative methods to link a company with customers, suppliers and internal stakeholders (Hammer and Champy, 2009), some of the most significant effort in a project such as this is around the persuasive and human elements. CRM in the public sector tends to be less well-developed than in the private sector and this may present an opportunity for organisational learning and a wealth of practice base from which good practice may be developed. Insofar as CRM systems are used in higher education they tend to be used as a mechanism to engage with potential, current or past students in what is often termed Student Lifecycle Relationship Management. CIT's use of the CRM system for engagement with the business and enterprise community was novel within the Irish higher education sector and is supported by the Higher Education Authority (HEA).

CIT's CRM project allows users to gain an insight into engagement with community and enterprise and to share this knowledge across departments and business units. The implementation of a technological solution was one of many steps in this endeavour, more importantly, it was about bringing people and processes from different areas of the institute together in a structured way and utilising the CRM system to enable this. The intention is that, at any one time, the very broad range of interactions with an external partner can be viewed and explored in depth as required.

The CRM system allows CIT to understand, map and learn from engagements and to improve and build on them. Organisations that contribute to learning, research and development activities are the "customers" of the Institute. An engagement could be anything from customised learning, project sponsorship, guest lectureships to Alumni and recruitment. A single Institute-wide shared database was required in order to become competitive and "attract, retain and serve" short and long-term "customers". Every piece of interaction counts towards the overall company/enterprise experience with the Institute. It is about enhancing the value and effectiveness of existing relationships, embracing change and sharing knowledge and increasing the effectiveness of the institution in interacting with external organisations. Such a comprehensive system has the advantage of providing the institute's management with an informed overview of the complex relationship between the institute and external organisations. As well as providing an opportunity to understand analyse and nurture existing relationships it provides an informed strategic framework for the targeted development of new relationships.

2.2 Drivers and barriers

CRM is new to higher education and contradicts the silo approach to engagement that can hamper proactive collaboration and interaction with the external world. Knowledge sharing is difficult and culture change is imperative in order for a CRM project such as this to succeed. Technological change is inevitable in all organisations, and, according to research by Hayes *et al.* (2008), has placed added pressures on organisations within the educational sphere. Likewise, Jamali (2005) believes that increasing technological complexity and the need to diffuse information and technology within organisations is proving to be beyond the capacity of existing rigid hierarchal management systems. The introduction of a significant change in the collation and use of information is sensitive and difficult. The approach taken is to allow the project to grow organically and build trust among the stakeholders. Innovative individuals are key champions for the project that will help the implementation process and have a positive impact on the project as a whole.

A key driver for a CRM system for engagement is the external organisation seeking to interact with Higher Education. Clarifying the points of contact and ensuring that the breadth of engagement interaction potential is understood by the external partner are two important aspects of an informed approach to partnership. For any large organisation maintaining current overview of capability and capacity in a dynamic environment can present challenges. Ensuring that the system is structured to meet the needs of the external partner in a meaningful way acts as a very positive motivation. As Jenkins (2010) states 'the customer's perception is that they are dealing with the 'university' irrespective of the department/school with which they are actually interacting.'

Another motivating force comes through articulating clearly the benefits for the institution and staff. Developing an overview of the complex map of relationships between the higher education institution and industry partners has the potential to provide each of the interacting agents with an informed perspective, thus avoiding the potential embarrassment of encountering interactions between a partnering organisation and the institution of which they have no knowledge.

While benefits for the external enterprise, the institution, the students and the generation of social and economic value for the region are the main drivers behind the development of systems and structures to support engagement, there are many barriers to the successful implementation of a CRM system.

Finnegan and Currie (2010) point to the organisational change and disruption implicit in such a project. They stress the organisational elements and the difficulty in aligning business process and disparity in the views held. Perry *et al.*(2011) stress the importance of building trust and of overcoming the difficulties and concerns around information sharing and the need to demonstrate the value to potential users. There is a clear need to support employees through training, recognition and rewards (Becker *et al.* 2010). As with any change management process the importance of allowing time to build trust in the project and constant communication is paramount.

3 Main results and findings

People and culture are two of the most important factors when considering any change initiative and a CRM system is no different. Although managing knowledge, and particularly knowledge about relationships, is fundamentally about people who hold those relationships, it can be difficult to share this knowledge within an organisation without the use of technology. CIT initiated a pilot project to implement a technology solution on a trial basis in order to structure and support the sharing of knowledge between colleagues in the institution about engagements with external enterprises and organisations. At the time there were “small islands of knowledge sharing” but no “bridges between these islands” (Smith and McKeen 2009).

A number of questions were raised as part of the CRM feasibility study:

› People: Is there management buy-in? Is there grassroots support? Is there support from various departments and business units?

› Process: What does this organisation do? Does sharing occur at data, information or knowledge level? How is the sharing process facilitated?

› Technology: What technologies are currently available for sharing this type of information? What level of technological experience is present within the organisation? What new technologies might be most appropriate for this organisation?

Many papers suggest that a technical CRM implementation cannot take place until the cultural and process issues are dealt with. At CIT, the approach has been to deliver an out-of-the-box CRM system and sell the basic benefits to users and business units before customising for their group needs. In this way the system would itself aid the decision-making process and provide the background knowledge to further the initiative.

3.1 CIT’s CRM for engagement

CIT implemented a low cost online hosted solution that can be moved on-premise if required and is scalable as the project grows. The project gained the support of a project sponsor and management in the form of the IT Steering Group and a member of the Institute Executive Board. A CRM Usage Policy was created for all users in order to support good practice in the use of the system. , ‘Champions’ or change agents were identified in key areas to act as early adopters helping to shape the solution and to encourage a positive view. As the project was supported by the HEA it was important to ensure that an open approach to dissemination was maintained throughout.

3.2 Requirements gathering

A range of techniques were employed to capture the broad set of requirements that were necessary for CIT to use a CRM system for engagement, these included presentations, brainstorming techniques, use-case diagrams, structured interviews and workshops. Initially the drive for the development of the CRM solution came from the newly formed CIT Extended Campus who articulated the need for:

- a structure to map the overall external engagement activities of any CIT unit at any point in time – as both a record and a stimulus
- a structure to 'map' the range of activities with any organisation at any point in time – as both a record and a stimulus
- an easy-to-use record of communications and interactions with external organisations, particularly the logging of initial 'expressions of interest' and creation of 'new projects'.
- a 'task listing' of what's active and what needs to be driven or monitored

An important early stage in the project was to consider the potential range of interactions with external organisations, in which the institute is and could be engaged. The work of the REAP project team and the concept of the partnership continuum described by Sheridan and Linehan (2011) was expanded to consider the full range of interactions. Codifying this for the purposes of analysis, the types of engagement interactions with enterprises and organisations are loosely grouped as:

Curriculum and teaching collaborations:

- Enhancement of employability and entrepreneurial skills
- Course design, development and review
- Guest lectureship and adjunct faculty
- Careers fairs and company visits
- Extern examiners
- Work placement and internships
- Graduate recruitment
- Professional bodies

Customised learning

- Recognition of prior learning
- Work-based learning
- Continuing professional development
- Flexible and on-line learning

Research and development

- Consultancy

- Specialist facilities and equipment
- Funded undergraduate projects
- Applied research projects
- Feasibility and commercialisation
- Patents and licences
- Supporting entrepreneurship
- New enterprise support and incubation

General and civic engagement interactions

- Alumni
- Memberships of boards
- Sponsorship
- Volunteering
- Service learning
- Sporting and sports facilities
- Concerts and exhibitions

While this list is not exhaustive it is typical of the higher education landscape in Ireland and serves as a useful starting point for the consideration of the interactions types and the benefits that can accrue from a coordinated approach. It also served to focus on the various types of information on engagement extant in the organisation at the outset and the locations and formats in which that information is held. A diverse range of practices existed in relation to process analysis in the various organisational units involved in external engagement and the requirements gathering process helped to analyse the process stages and to recognise good practice. This analysis and reflection stage was very important in helping to illustrate the benefits of a structured approach to the external customer.

After an initial pilot phase, a decision was made to implement Microsoft Dynamics CRM 2011 Online as the CRM solution for CIT. The advantages of using a hosted solution over an installed solution were:

- No major upfront costs
- No hardware requirements or resource requirements
- Easy-to-use, user friendly configuration
- Manageable time commitments

Using Microsoft Dynamics, information can be shared across the Institute allowing users to understand and strengthen existing relationships and nurture new ones. CRM can also be used to implement or automate business processes where data entry, workflow, and reporting are required.

CRM is intended to evolve as a useful resource for the benefit of CIT stakeholders and is now in use in CIT since September 2011. Initially it was implemented with one business unit on a trial basis and has now been rolled out to eight business units including an applied research centre and a number of specialist academic units and departments.

3.3 CRM Usage Policy

As the initiative gained momentum it became obvious that the collation of contact information relating to external interactions is sensitive. As Jenkins (2010) reported there is a fear that the contacts and relationships nurtured by individual staff members would be damaged by a central approach that would bombard them with ‘junk mail’. Interestingly, the staff members often had the impression that they were alone in their interactions with particular external contacts or organisations and did not realise that, in some cases, many others in the institute also had connections to ‘their’ contacts. This overlapping of interactions became clear from the start of the initiative as soon as two different business units had included ‘their’ information on the CRM system. To support the development of clear protocols, a CRM Usage policy was created to manage the extent of the CRM deployment or its suitability for particular operations in the Institute and is governed by an executive customer. The executive customer is responsible for oversight on the strategic direction and resourcing of the CRM System, and acts as a point of escalation for decision making and policies relating to the system. This policy assigns a Service Owner and Process Owners in each of the business units. The Process Owner is responsible for ensuring that a business process is fit for purpose. They should define the business case and the requirements, sponsor the solution, and participate in design and continual improvement of the solution.

CRM users undertake to keep all data as accurate and up-to-date as possible, and to adhere to the formatting standards that are agreed to ensure the integrity of the information in the system. They also agree that at an overview level ‘their’ entity data is visible to all users of CRM. Security Roles restrict the sharing of some data at more detailed levels.

3.4 CRM Champions

Project champions are an important resource on any change project. A recurring issue during the rollout was the reluctance to share information on contact details or interactions and engagements. By way of workshops a number of champions/stakeholders who were willing to be involved in the development of the system were identified in areas of the institution with significant engagement interactions with enterprises. Rather than seeking to impose a system on those with reservations the intention is that, through the champions, the benefits of adopting the system will be demonstrated in time. Statistical analysis shows over seventy percent of change initiatives fail (Beer and Nohria, 2000).

The impact of changes and the change process on individual employees is the subject of much research; with most agreeing that employees find the process difficult (Carroll 2007). Change, therefore, is difficult and the change process should be approached with care. Humphreys and Langford (2008) believe that the failure of these change processes is often due to senior management's view that change is a dramatic and monumental event rather than a subtle journey. It is intended that this initiative will be afforded the time to undertake that subtle journey which will overcome the uncertainty and fear which often surrounds a change process. The intent is that, working in a consultative way with the champions, the benefit of sharing this knowledge will be shown to far outweigh the concerns and will lead to a successful project. The important thing to note is that a considered approach is best suited. People need to see the value of a CRM approach before they will adopt the new technology and culture that is required.

3.5 In practice

Currently the participating business units are using the CRM system to:

- Share Account and Contact information across departments
- Understand and record the breadth of existing projects and the associated activities
- Analyse and track these activities
- Manage new projects and cases as they arise
- Identify opportunities for new engagements
- Interact with customers and manage events in a centralised manner
- Perform standard business processes such as contact management, task scheduling and tracking, appointment/calendar scheduling, email support and document storage.

There are a number of factors that have been found to impact on users' interactions with the CRM System:

- Users will need to conform to the CRM Usage Policy
- Usability and accessibility of any system is a key factor to its success. Technical difficulties can obstruct collaboration among users
- Collegiality – respect for information from a variety of sources
- Data Protection concerns around sharing account or contact information with a wider community

- Security and intellectual property: the sensitive aspect of the information being shared
- Commitment of time and resources

3.6 Sharing experiences and expertise

As part of the development of systems and structures to support and encourage engagement nationally, CIT has attended a number of "roundtable" discussions with higher education institutions in Ireland such as Trinity College Dublin (TCD) and National University of Ireland Galway (NUIG) among others. The implementation initiative is a continuous learning and collaborative experience. Each institute is an early CRM adopter and sharing experiences is providing valuable knowledge to support further organisational learning. The intention is that a peer group will meet on a regular basis to support strategic CRM collaboration and implementation.

4 Discussion of findings/results to date

4.1 CRM Strategy

A CRM strategy is essential in order to provide direction and focus (Perry *et al.* 2011). The need for a clear strategy is not driven by technological considerations but by the need to understand the implications for staff and to predict, prevent and where necessary remove, any barriers to CRM adoption. For the success of any change initiative a long-term plan which outlines and clearly communicates the goals is a vital starting point. For this initiative it was recognised that a "big bang" approach was not the way forward. Supporting and building on the success of individual users and championing this success to new users allowed incremental adoption but the longer term, clearly stated goal, set the context and the backdrop within which this could be effective. It was important that the system was designed so that it integrated with the users existing email application and could easily become part of their daily work toolkit.

4.2 Engagement strategy

The implementation of a CRM system to support engagement in CIT should be seen in the context of the institution's Strategic Plan. Within the plan the mission statement articulates the commitment to 'continue to be a national and international leader in enterprise engagement and the practice of extending the education campus into the workplace and the wider community'. It goes on to outline the need to develop an institute-wide commitment to engagement and a professional outward-looking interface through which external communities, organisations and enterprises can interact with CIT. The alignment of the pilot project with the institute plan has ensured that the approach is consistent with the overall engagement strategy and has helped in the acceptance of the CRM approach generally.

4.3 Guidelines for a successful CRM implementation

While this initiative is far from complete, there are some useful lessons that can be gleaned from the work to date that may be of value to similar projects.

(1) It is imperative that the initiative be clearly aligned to the institutional strategy with strong support from the institute executive

(2) While management level buy-in is important, the users must be convinced of the value of the system. This can be ensured through a reflective process of requirements gathering and through articulating and evidencing the value to the user base

(3) Changes in knowledge management and sharing do not happen quickly. Time allows new ideas to be socialised and permits some reflection on practice

(4) Organisational culture has a huge influence on how change is viewed and adopted and should be well understood. Technology cannot overcome cultural barriers

(5) Users and potential users do not always know what their requirements are or what the potential benefits are to them. It is important to communicate continuously and provide opportunities for learning and feedback ensuring that the CRM system can evolve

(6) Sharing experiences with other organisations who have undergone, or are currently undergoing, a similar initiative is really valuable to sustain motivation and develop a learning community

(7) Keeping the focus on the customer or external organisation and helping the internal user to see the system from the customer's perspective helps to maintain the impetus

(8) Champions are necessary to help gain support and contributions and to provide real evidence of the benefits

(9) Consider how the success of the initiative will be measured

This final point which addresses the measurement of success of the project has been given some considerable thought in practice. Davenport *et al.* (1998) mention a number of success indicators for knowledge management projects which are relevant in this case.

› Growth in the resources attached to the project.

› Growth in usage and volume of content or contributions.

› Likelihood that the project would survive without the support of one individual.

› Evidence of financial return.

Developing a set of metrics which will become the instrument by which success and impact can be measured will form part of the next stages of this project.

5 Conclusion

It is often stated that organisational culture, not technology has a greater impact on whether people exchange knowledge effectively (Orlikawski 1992). People are an organisation’s most important resource and in the case of CIT, these people include employees, current students, researchers and external contacts. The complex links with the external communities include for instance: guest lecturers, external examiners, course advisory groups, recruiters, graduates, lifelong learners, professional and awarding bodies, sponsors, research and development partners, among others. Creating a structure which leverages information on existing interactions to develop benefits for more or improved interactions is the main motivation for this initiative. In the current economic climate, it is seen as essential, that the Irish higher education system interacts effectively with the enterprise community to contribute to the development of economic and social value. Using a CRM system to support the development of more and better-informed interactions has the potential to yield significant benefits. This paper describes the early stages in the development and implementation of such a system.

This particular CRM project is a slow-burning success. What started off with three users now has 40 users. Data is being entered into the system every day in the form of accounts, contacts, leads and engagements. Customisations, including workflows are enhancing the system at regular intervals through interactions with the Higher Education Authority and the wider education community in Ireland it is intended that this system will provide the blueprint for a CRM for engagement nationally.

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Student Driven Business Incubation: Empowering Student Entrepreneurs In University Business Incubation

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Abstract

University business incubators (UBI) are an established means for stimulating academic entrepreneurship. However, research has shown that most UBIs do not meet expectations. We present a new UBI sub-type we call the 'Student Driven Business Incubator' (SDBI), which is mainly managed and driven for and by student (entrepreneurs). First we identify four challenges to existing UBIs Based on these challenges, supporting and restricting characteristics and two case studies we develop the new sub-type of UBI. This type of UBI is based on a hybrid management approach between bottom up management by students and top down guidance by the parent university. We believe the SDBI is a fit alternative to (costly) top down managed UBIs. We discuss the strengths and possible challenges of the SDBI. Future research directions on Student driven incubation are provided in the discussion section.

Keywords

University business incubation, student entrepreneur, bottom up business incubator, student driven business incubation.

1 Introduction

Business incubators can function as a catalyst for development of new companies by linking ideas, know-how, technology and capital. They provide several services that aim to increase start-up companies' chances of growth and survival in the first few years of their existence (e.g. Grimaldi and Grandi, 2005; Ratinho and Henriques, 2010; Somsuk et al., 2010). These services vary from developing business plans, attracting investors, providing networks and other specialised services. Grimaldi and Grandi (2005) distinguish four different kinds of business incubators; Business Innovation Centres, University Business Incubators, Independent Private Incubators and Corporate Private Incubators. In this paper we focus on University Business Incubators (UBI).

University Business Incubators are, as their name implies, directly connected to an University. Since 1990, more and more Universities engage in developing these kind of business incubators. Their vision was to use University Business Incubators to foster the transfer of academic knowledge to the market place by stimulating academic entrepreneurship (e.g. McAdam and McAdam, 2008; Colombo and Piva, 2012; Somsuk, Laosirihongthon, and McLean, 2012). However, the results of these incubators are disappointing as most University Business Incubation programs do not meet the expectations (Wright et al., 2003; Degroof and Roberts, 2004, Trott, Scholten and Hartmann, 2008). As Wright, Lockett, Clarysse and Binks (2006) notice; 'there is a distinction between the creation of spin-outs per se and the creation of spin-outs that create significant wealth.' Trott et al. (2008) emphasize the difficulty most academic entrepreneurs have in transferring their knowledge to the market. In fact, some UBI services even obstruct spin-out companies in their business goals, growth and/or survival. We suggest that these problems arise due to the top down management approach most UBIs employ. Using a bottom up approach to business incubation, as Bollingtoft (2012) implies for regular business incubators, seems especially fruitful for applying to university business incubators to improve their efficiency and effectiveness.

Therefore, we propose a new management approach to overcome the before mentioned issues of UBIs. We define this approach as student driven business incubator (SDBI). As the name implies, the SDBI specifically focuses on student entrepreneurs and academic entrepreneurship. The incubation process is bottom up driven and managed by this target group. It contains both characteristics of the UBI and the bottom-up business incubator. Therefore it can be seen as a hybrid approach to business incubation of academic entrepreneurship.

To the best of our knowledge, no academic research has yet been published regarding a student driven or bottom up approach to UBIs. The current research addresses this gap in academic literature. The goal of this paper is to provide academic groundwork for further examination of the suitability of a student driven approach to resolve the current issues of university business incubators.

This paper is structured as follows. First, we explain the methods used for this paper. Second, we propose our literature review on the concept of the university business incubator and the student entrepreneur, their advantages and challenges. We then present two cases on student driven entrepreneurship. Based on the findings on UBI's, student entrepreneurs and our cases, we address our concept of student driven incubation and explain the advantages and challenges of this type of university business incubation. We then present a discussion section which addressed four possible future hypotheses and end our paper with a conclusion, our limitations and future research possibilities.

2 Method

For the current research we conducted a literature search within the field of business venturing with a focus on academic start-ups and in the field of university business incubators. Additionally, we examined two cases studies of UBIs with Student Driven aspects. We used the academic database of Scopus for our literature research. This database captured most of the relevant journals on business venturing and incubation based on their impact number (What does Scopus cover, n.d.). To adjust for missing articles we also entered the search terms in Google Scholar. Because Google Scholar filters on titles build up from the entered search terms, we used this search engine to saturate our literature sample. Our search terms were: 'business incub* typology', 'university business incub*', 'university incub*', 'manag* university incub*', 'student business incub*', 'student incub*', 'manag* student incub*', 'efficiency university business incub*', 'bottom up incub*', 'bottom up university business incub*', 'bottom up university incub*', 'top down incub*', 'university business incub* management style', 'university business incub* management approach', 'academic entrepreneur' and 'academic entrepreneur characteristics'. The stars are so-called wildcards, they are automatically replaced by all possible conjugations of the search terms. For more information regarding wildcards see Wolfswinkel et al. (2013). Our search resulted in 56 relevant articles. Using cross references, correcting for doubles and extensively reading the abstracts and full text of the articles we narrowed down our literature base to 29 highly relevant articles. To be able to perform a comprehensive analysis of the body of literature, we used coding procedures like those described in Wolfswinkel et al. (2013). The coding procedures were applied as follows. We read the articles from the selected sample one by one in a random order. Everything that seemed relevant for our research was highlighted; Wolfswinkel et al. (2013) call these highlighted parts 'excerpts'. We then performed so-called 'open coding' to transform these excerpts into concepts and were applicable these concepts into categories. Through 'axial coding' relations between the concepts were identified.

For our case study we selected an American and European business incubator. Research has shown that the most efficient business incubators are situated in developed countries (Mian, 1994) We decided to focus on technology driven science parks, near a university. The UBI needed to be managed by students. Therefore we chose the StartX UBI (Silicon Valley, U.S.) and the Student Union UBI (Business and Science Park, the Netherlands) To examine the case studies we conducted 2 qualitative interviews per case study. One with management, one with an involved student. Next to that we visited both sites and searched the internet and their website for additional information. We are aware that our case study analysis is still limited in this present preliminary stage of research. However, we believe that together with a thorough literature study we can identify enough advantages and challenges to give an introduction in the concept of Student Driven Business Incubation.

3 Literature review

Business Incubators create a safe and surrogate environment to support the initiation, growth and survival of new firms (e.g. Aaboen, 2009; Bollingtoft, 2012; Mian, 1994). Business incubators aid entrepreneurs in minimizing liabilities of newness and smallness (Trott et al., 2008) and decreasing perceived uncertainty surrounding new start-ups (Westhead and Batstone, 1998). Business Incubators are tangible locations with at least five defining services, (1) office space, (2) office support, (3) access to financial resources, (4) entrepreneurial start-up support and (5) access to networks, these are 'typical incubator services'. (Carayannis and von Zedtwitz, 2005; Mian, 1996). As mentioned before there are four types of business incubators; Business Innovation Centres, University Business Incubators, Independent Private Incubators and Corporate Private Incubators (Grimaldi and Grandi; 2005). Our research specifically focuses on University Business Incubators. We now continue to elaborate on the topic of this specific type of incubator.

3.1 University Business Incubators

University Business Incubators are usually set up by Universities and/or government programmes. Their mission aims to increase academic entrepreneurship and stimulate the technological development and innovation of national and regional economies by transferring academic knowledge to the market place (e.g. Grimaldi and Grandi, 2005; McAdam and McAdam, 2008).

3.1.1 Environment and Stakeholders

The description of the origin of UBIs directly points out their multi-levelled environment (Phan, Siegel and Wright, 2005). Phan et al. (2005) identified (1) the government and university systems which allow for a UBI to originate and grow, (2) the level of the UBI itself, (3) the firms within the UBI and (4) the (teams of) academic entrepreneurs who are involved these firms. These entities all have a direct interest in the University Business incubator (Aaboen, 2009) and therefore should be taken into account when designing a new management approach for University Business Incubators.

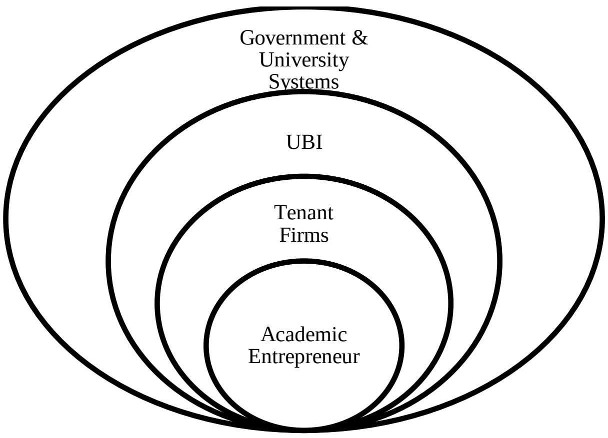

Fig. 1: Multi level analysis of direct environment of UBI

Next to the Government and University systems in the upper level of the UBI, venture capitalists and other financial actors can be identified which may or may not (directly) interfere with the UBIs policy (Aaboen, 2009). In general, UBIs tend to rely on University and Governmental support only (Grimaldi and Grandi, 2005). Please note that the different levels within the environment also incorporate different stakeholders. As stakeholders differ from UBI to UBI we only mention the most common stakeholders, starting at the lowest level of analysis. The core stakeholder of any UBI are its academic entrepreneurs. At the second level we find the tenant firms, which are started by the academic entrepreneurs. Note, that the needs of academic entrepreneurs may differ from the needs of their companies for survival and growth. This may imply a different approach to managing the tenant firms as stakeholders. At the third level we find the University Business Incubator itself. Stakeholders in this level may include the UBI's management team, service team and other people involved in the UBI. The top level involves stakeholders such as business venturing agents of the University, regional development agencies, governmental policy makers and financial actors (Aaboen, 2009).

3.1.2 Services and Resources

Next to 'regular' incubator services such as office space, office and entrepreneurial start-up support and access to financial resources and networks, UBIs offer an additional set of specific services. These are referred to as 'university related services'. These include specific specialist knowledge and support, access to skilled student employees, university image conveyance, technological resources of the university, such as labs, equipment and computers, related R&D activities by other PhD students and access to other specialist networking activities, such as conferences. To support new technology entrepreneurship cheap access to these university related services is essential (Mian, 1996). This may impact and limit the geographic position of the UBI in relation to the 'parent'-university. For a University to start an UBI, it is necessary for the University to provide lab space and/or office space.

To provide the above mentioned services University Business Incubators in general employ four distinct types of resources; (1) human, (2) financial (3) technological and (4) organizational (Somsuk, Laosirihongthong and Mclean; 2012). Human resources include all human contact, ranging from support administrative services, training sessions to network events and even the network of the UBI itself. Financial resources refer to both the financial resources tenant firms can obtain, as well as the financial resources the UBI needs to acquire to sustain its existence. Technological resources are specifically applicable in a high tech setting, when tenant firms need for example laboratories or specialised equipment. Intellectual property rights are also part of the technological resources. It is not uncommon for a UBI to use the technological resources of the parent university (Trott et al.; 2008). Organizational resources include shared office space, low rent etc.

To determine which and how many resources should be allocated to the different services, Somsuk et al. (2012) set up a priority list of the services offered in an UBI. The four most important enabling services for increasing UBI efficiency are 'talented manager', 'access to financing and venture capitalists', 'selection process for tenants' and 'technology/idea'. Prioritizing is important for management to successfully allocate the right amount of resources and time to the right services. 'Infrastructure' for example is the least influential on UBI success. For an overview of the whole list, see Somsuk et al. (2012:614).

To measure success of UBIs, Mian (1997:281) identified three main performance dimensions; (1) Performance outcomes, (2) Effectiveness of Management Policies and Practices and (3) Services and their value added. Performance outcomes are measured in four different types of (often measureable) objects; (1) the program sustainability and growth, (2) Tenant firm's survival and growth, (3) contributions to the sponsoring university's mission and (4) community-related impacts. Research has shown that UBIs tend to foster start up creation, but fail in preparing them for survival (Wright et al., 2006). Using the performance dimension 'performance outcomes' one can assess whether or not the UBI has reached the predefined performance measures.

The performance dimension Effectiveness of Management Policies and Practices can be used to assess UBIs management policies. This dimension includes (1) the clarity of goals, organizational structure and governance, (2) finance and capitalization, (3) the clarity and performance of operational policies and (4) the target markets. The last dimension Services and their value-added gives a review of the performance of the offered services of the UBI. This performance dimension includes services such as (1) the common business incubator shared office services and (2) University related services. Trott et al. (2008) point out that many of the provided services of UBIs are perceived as unnecessary by their tenant firms. This can be resolved by making the entrepreneurs themselves responsible for the services provided for them (Bollingtoft, 2012).

Many universities agree on the desirability of an UBI to stimulate academic entrepreneurship. However, Business Venturing research shows a number of characteristic challenges that UBIs still need to overcome.

3.1.3 Challenges

Based on our literature research, we identified four main challenges for UBIs to overcome. These include: Over-protection issues, Ivory Tower issues, Managerial issues and Dependency issues.

Types of issues	
Over-protection issues	- Cushion effects - Remoteness
Ivory Tower issues	- Product myopia - Academic networks
Managerial Issues	- Top down-one-size-fits-all management approach - Unnecessary services due to: - No specific (technology) knowledge - No entrepreneurial experience

Dependency Issues	- Financial dependency on parent university - Focus on firm creation instead of survival

Table 1: types of issues of UBIs

Among others, Trott et al. (2008) address the topic of over-protection of an UBI as a hampering factor for tenant firms. They introduce the terms cushion effects and remoteness. Cushion effects imply that the start-up is placed in a safe environment to prevent it from instantaneous failure. Although at first glance this may seem beneficial for the start-up firm, cushion effects prevent learning opportunities in the commercial environment. This might cause problems when the firm tries to survive outside the UBI. However, if a firm stays too long within the UBI this can constrain its freedom, due to constricting management approaches. It can also signal to its customers and competitors that the firm is not mature enough to stand on its own two feet. This can result in competitive disadvantage, due to lack of legitimacy. Remoteness also includes the removal of the start-up firm from the harsh economic competitive environment. Being outside the competitive environment can dissolve the feeling a company has with the market and can make it much more difficult to make price based and economically rational decisions (Grandi and Grimaldi, 2005; Trott et al., 2008)

Ivory tower issues have to do with the genetic characteristics academics transfer to their companies. Academics and UBI management (which mostly consists of academics) tend to surround themselves with other academics (Ivory Tower syndrome) (Grandi and Grimaldi, 2005). This may lead to losing touch with the market and product myopia[1]. Next, Ivory tower effects may create rigid networks of academics and/or the same (academic) entrepreneurs. This hinders the development of new networks with potential customers, suppliers, competitors and other important stakeholders.

An UBIs management team has a significant influence on the amount and quality of services the UBI provides. One of the main goals of UBIs is to support as many start-ups as they can. Unfortunately, this often leads to a one-size-fits-all top down management approach with standardized workspace and standardized training. This has a negative impact on the tenants (Trott, et al., 2008) and their firm’s growth. The top down management style makes the UBI rigid and unable to adequately respond to necessary changes. Even, the quality of the UBI’s management teams in general tends to be insufficient for supporting tenant firms throughout later lifecycles. The reason for this is two-fold; most management teams are run by University employees without specialist technical knowledge (Dill, 1995). This restriction may impact a firm’s growth and survival. Next to that, University employees inhibiting the management team of the UBI in general are no entrepreneurs. Which can cause friction between the perceived needs of the student entrepreneurs by the management team and the actual needs of the entrepreneurs

[1] Product myopia refers to a product which is launched at the wrong time in a certain market. This then precludes possible other market opportunities, which negatively influences a firms competitive advantage.

as viewed by the student entrepreneurs themselves (Bollingtoft, 2012; Trott et al., 2008). This can lead to wasted resources on unnecessary services.

The last issue concerns the dependency of the UBI on its parent university. Most UBIs are dependent on their parent university for financial means and office space to sustain the UBI. Common performance measures used by university's for accessing the success of UBIs are based on numbers, such as 'number of start-ups created' and 'amount of employment created', instead on quality or a firm's survival rate. This may restrict tenant firm's growth and survival.

3.2 The Student entrepreneur

The core stakeholder of any University Business Incubator is the academic entrepreneur. According to Colombo and Piva (2012) the definition of academic entrepreneurs should include a wide variety of entrepreneurs who are directly connected to an university, such as (1) academic students, (2) full-time or part-time academic staff and (3) PhD students. Based on this definition of academic entrepreneur we identified two subgroups; (1) academic entrepreneurs who are not currently enrolled as a (PhD) student and (2) academic entrepreneurs who are currently enrolled as a (PhD) student. We focus on the second group which we define as 'Student Entrepreneurs', because our case-studies were limited to this group.

Roberts (1989) identified a number of personality characteristics of technical entrepreneurs, such as extraverted, intuitive and thinking-oriented. However, as Brandstätter (2011) pointed out, within the entrepreneurial literature to date there is no convergence found on specific personality characteristics of (academic) entrepreneurs and entrepreneurial success. Therefore, we focus mainly on general personal characteristics and do not take individual personality characteristics into account. This is important as research has shown that personal characteristics, such as knowledge and skills of the founders have a profound impact on the competencies of new academic firms (Cooper and Bruno, 1977; Feeser and Willard, 1990). We identified seven key characteristics of student entrepreneurs. Three which may stimulate academic entrepreneurship (and success) and four which may restrict academic entrepreneurship (and success). We divide them in supporting characteristics and restricting characteristics respectively.

3.2.1 Supporting characteristics

The most prominent characteristic of any student entrepreneur is his/her education level. Based on our definition, student entrepreneurs as least have an academic background. This implies a strong scientific and/or technical foundation based on the discipline of education of the student entrepreneur (Colombo and Piva, 2012). The second characteristic also relates to the highly educated background of the student entrepreneurs. This allows for a more horizontal style of management with less strict boundaries and increased responsibility of the student entrepreneurs themselves (Powell and Snellman, 2004). The third characteristic, academic networks is related to the academic education of the student entrepreneurs. During their education they build up a solid network with other students, academic teachers and other academic personnel. This enables them to easily gain access to new technology within their networks. This can foster innovation. The last characteristic has to do with age. Most student entrepreneurs tend to be of fairly young age (<27 years) (10 jaar Studentenmonitor hoger onderwijs, 2011). Young age is associated with a higher degree of innovativeness (Baron, 2006).

3.2.2 Restricting characteristics

Due to the definition of student entrepreneurs they are always bound to either their study (students) or their research (PhD students). This results in having to find a balance between their studies/research and the time they devote to their (start-up) firm.

The next restricting characteristic is pointed out by Colombo and Piva (2012). Although the majority of students have had part-time jobs on the side, they usually lack previous relevant work experience. Especially when it comes to starting up, developing and running a business. Next to the lack of relevant work experience Brüderl, Preisendorfer and Ziegler (1992) discovered that most student entrepreneurs also lack leadership experience. This might become an issue when the firm needs to grow and needs to employ personnel (McAcam and McAdam, 2008). As mentioned before academics and therefore student entrepreneurs too, might by affected by the Ivory Tower syndrome (Grandi and Grimaldi, 2005; Cooper, Hamel and Connaughton, 2012)

Student entrepreneurs' characteristics	
Supporting characteristics	*Restricting characteristics*
Academic education level	Bound to their study/research, therefore limited time
Preferred empowered management style	No previous (relevant) work experience
Academic network	Lack leadership experience
Young age	Ivory tower syndrome

Table 2: characteristics of student entrepreneurs

4 Case study

For our research we selected one case study from the US and one from the Netherlands, due to the cultural difference regarding equity-based financing. Equity based financing implies that in return for an amount of money the lender gets a share in your company. He becomes some kind of co-owner and more often than not has a (strong) influence on the way a company should be managed. Equity funding is quite common in the US, while it is rare in the Netherlands. Non-equity funding through the use of subsidised support in the starting phase of a company is more common in the Netherlands than in the U.S. Our case studies are both non-equity based business incubators.

4.1 Univeristy of Twente – Student Union Business Incubator

In Europe it is difficult to find examples of these student driven business incubators at Universities. In the Netherlands, in the region of Twente, there is one case of incubation, where students have played an initiating and partly managing role. In 1999 the University of Twente wished to enlarge the involvement of its student population. This initiated the birth of the Student Union (SU). The SU is a semi-autonomous institution managed by a board of approximately 6 students. The fact that a board of students instead of university employees has responsibility is unique within the Dutch context. Other examples of these type of student unions are found in the UK and Denmark. The SU has control over most of the students' leisure facilities and manages three different buildings on the campus. It is also responsible for promoting student entrepreneurship at the University of Twente. Although the SU has control over a number of office spaces for student entrepreneurs it regards itself as idea generator, instead of a facilitator. After visiting we found out that the student companies each have separate office spaces. These spaces do not enhance interaction, open innovation and co-operation, due to their geographic position. Since the start in 1999, 30 students companies have used the office spaces. The SU mentioned that due to budgetary cuts there are limited means to provide relatively cheap office space, and to get credits or other benefits for managing activities. Therefore the SU focuses on idea generation and initiating activities to stimulate student entrepreneurship. These include awareness raising events, workshops, consulting, coaching, scouting, and incubation. However, they do not organize and execute these activities themselves, this task is delegated to Kennispark. This foundation is joint initiative of the University of Twente, the City of Enschede and the Province of Overijssel, to support academic entrepreneurship, technology transfer and science park development. Kennispark organizes student events, and provides consulting, coaching, and preseed loans to students.

Approximately 70 students per year use the coaching and consulting facilities of Kennispark. When there is a situation of intellectual property or need for venture capital, the business development team of Kennispark gets involved. This team exits of university employees. Therefore we conclude that, although the start of the business incubation program by the SU was student driven, it has evolved into a hybrid model between university employees and students.

4.2 Stanford University – StartX Business Incubator

The university of Stanford started in 2012 with a new non-equity based university business incubator initiative, called StartX. The mission of StartX is to identify and accelerate the development of the highest-potential Stanford founders through experiential education and collective intelligence. It is solely focused on students and faculty members of the Stanford University. The management team of StartX consists, just like the SU, of students and recently graduated students. Its management style is highly participative. StartX advocates that it uses 7 key resources to successfully generate and support student companies. These are (1) Community: A close-knit peer community of the best Stanford entrepreneurs who learn from, motivate, and support one another, (2) Alumni Network: A network of 250+ high quality StartX alumni founders in all industries and from all backgrounds who have raised on average $1.5M per company, (3) Mentorship: Top tier mentorship from 200+ highly-vetted serial entrepreneurs, investors, and industry experts, (4) Training: Access to training and information from relevant experts in any industry to guide founders in every aspect of starting a company, (5) Resources: Over $100,000 of free resources: office space (provided by the City of Palo Alto), free legal, banking, $60k cloud computing, accounting and software, (6) Financial Aid: Need-based financial aid to founders and (7) Access to Capital: Connections to every top investment firm and angel group, as well as a large number of individual angel investors. As we can see StartX uses a combination of common BI services and university related services as identified by Mian (1996). Within the StarX program there are 3-monthly accelerator programs which aim to propel a start-up founder forward. Approximately 2000 founder initiatives apply for the programme each year. This is over 12% of the total population of Stanford University. Based on thorough screening and selection procedures by the student management team only 60 of the initiatives are excepted per year.

Until now, 210 founders and 60 companies graduated from the accelerator program. According to their own findings (www.startx.standford.edu; interviews) their founders have made very good progress. Eighty-five percent of the founders' companies are funded and still growing. The companies have released products, been acquired, and are mostly profitable. Over 80% of the companies supported by StartX have together successfully raised over $100M in funding. An average of $1.51M per company.

Since StartX is a relative young initiative only existing for two years it is too early to see any undermining problems.

5 Student driven business incubator

To date, literature has invoked many efforts to optimize the incubation process of UBIs. However, UBIs based and designed upon these literature streams tend not to reach their expected the financial return from commercialisation of academic research. The bulk of these start-ups tend to remain small (Wright et al., 2003; Degroof and Roberts, 2004, McAdam, Galbraith, McAdam and Humphreys, 2006; Trott et al., 2008). Based on our case studies and identified UBI and student entrepreneur characteristics, we therefore do not propose a way of optimizing the current incubation processes. Instead, we propose a whole new approach on managing the UBI, namely student driven incubation.

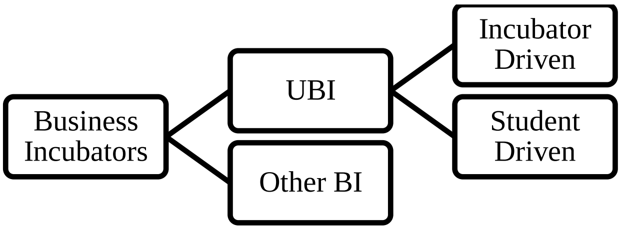

Fig. 2: The distinction between common UBI (incubator driven) and Student Driven Business incubation.

The goal of the student driven business incubator (SDBI) is to successfully stimulate student entrepreneurship, by incorporating the student entrepreneurs as managers of the Business Incubator. A SDBI both incorporates the five services of any business incubator; (1) office space, (2) office support, (3) access to financial resources, (4) entrepreneurial start-up support and (5) access to networks (Carayannis and von Zedtwitz, 2005; Mian, 1996) as well as the university related services (Mian, 1996). The key difference lies in the hybrid bottom up management approach. The most important institution of a SDBI is its student board. A SDBI is bottom up managed by a board of student entrepreneurs (like we have seen in the cases), who also participate (or have participated) in the incubation program, hence ’student driven’. Therefore they have experience with both the management side (they already functioned within the BI) as entrepreneurial issues (through their own venture). However, a SDBI is not entirely bottom up oriented as Bollingtoft (2012) suggests. Due to the restriction characteristics (see chapter III) of student entrepreneurs solutions must be found to overcome these deficiencies. To provide knowledge continuity, financial and office support the parent university stays linked to the SDBI. In short, the SDBI is a hybrid form between a purely bottom-up business incubator and a top down organised university business incubator. This hybrid form is partially based on the advantages and challenges of student entrepreneurs. Table 3 provides a short overview of the main advantages and challenges of a SDBI approach.

Student Driven Business Incubator approach	
Main advantages	*Main challenges*
Resolves all UBI’s management issues	Continuity issues
Better suited management style	Dependency issues
Lowers financial dependency on parent university	Board specific issues
Provides better alignment of education and entrepreneurship	Legitimacy issues
Reduces Ivory tower issues	Over-protection issues
	Reduces Ivory tower issues, but not eliminates them

Table 3: The main advantages and main challenges of a SDBI approach

5.1 Main Advantages

5.1.1 A Student Driven Business Incubation style resolves all UBI's managerial issues (see chapter III)

The biggest advantage of an SDBI with respect to a common UBI is that it resolved all identified UBIs' managerial issues (top down-one-size-fits-all management approach; unnecessary services, missing (technology) knowledge and missing entrepreneurial experience).

As mentioned, UBIs tend to have a one-size-fits-all approach, while our proposed student driven incubator is a flexible adaptive solution that fulfils the needs of the one by addressing their needs bottom up. Due to the flexible, adaptive nature, an entrepreneur can be supported throughout several different stages of their business life cycle. Therefore, it is possible for entrepreneurs to reside within the incubator for a longer time. This promotes not only the initiation of start-ups but also their growth.

Westhead and Batstone (1998) found that a large portion of the management and business assistance offered by business incubators is incubator oriented and often perceived to be unimportant by tenant firms. The SDBI adjusts its program to the needs and wishes of its tenants. If a company needs specific (technology) knowledge the SDBI board can attract this from outside the business incubator, by using its network and the helpfulness of alumni of the SDBI. Their management and business assistance is therefore needs oriented. This implies a higher amount of independence of the student entrepreneurs, but saves costs on unnecessary and unwanted assistance and training. If the SDBI can ensure that its board exists of (former) student entrepreneurs the deficiency between student entrepreneurs and management is resolved.

5.1.2 The management style of a SDBI is better suited for highly educated entrepreneurs.

As mentioned in chapter III under student entrepreneurs supporting characteristics, a empowered management style is desirable to use the full capacity of highly educated student entrepreneurs. A bottom up approach desires much more initiative and incentives than a top down approach, and might therefore be better suited to manage these specific kinds of entrepreneurs.

5.1.3 A SDBI approach lowers financial dependency of the BI on the parent university

In general UBI's management team consists of paid university employees. A SDBI approach replaces these pay-roll employees with unpaid students. This not only increases the similarities between management and stakeholders, it also saves costs, because of the wage difference. However, it is advisable to the parent university to install college credits for managing the SDBI. This way student entrepreneurs will have an incentive to undertake even more activities alongside their education and business venture.

5.1.4 It provides better alignment of education and entrepreneurship

By managing the SDBI needs oriented, it is possible for student entrepreneurs to enjoy the support of the SDBI for a longer time. For student entrepreneurs this means not having to choose between their business and their education. They can simultaneously study and develop their company, due to the extra specialised support the SDBI provides. This extra support will save the student entrepreneur time, which he/she can use to finish his/her education. Next to that an university can choose to take up student entrepreneurship as part of its curriculum so that student entrepreneurs can both work on their ventures as well as on getting their college credits.

5.1.5 Reduces Ivory tower issues

Due to the limited financial resource of the SDBI they need to find creative ways in providing their tenant entrepreneurs with training and guidance. By using graduated student entrepreneurs as mentor or trainer the SDBI ensures contact with the market, and tightens their relationship with existing firms. This approach aims to reduce ivory tower issues by incorporating these feedback loops from graduated student entrepreneurs' firms back into the student driven business incubator. Next to that, ex-SDBI members feel connected to the SDBI. Based on this feeling of connectness we argue that SDBI graduates are more willing than third party trainers to provide mentoring and training for free or a low price.

5.2 Main Challenges

5.2.1 Continuïty issues

In contrast to a regular UBI, the management of a SDBI consists of students. Due to their obligation to their education and their company the board switches every year. With every board change knowledge and relationships will be lost. New boardmembers need to get used to their function and may be underperforming the first few months due to lack of management experience. Therefore a solid body of knowledge should stay incorporated in the SDBI, just as it is in the UBI. This may take form of a University councillor with specialised knowledge on entrepreneurial and/or high tech processes. This councillor will not interfere with any management tasks.

Further, one of the main threats to any bottom up business incubator is missing initiatives from the entrepreneurs (Bollingtoft, 2012). The initiatives of s SDBI mainly rely on the before mentioned board. If a SDBI cannot find enough students to participate in the board the SDBI will not survive. Taking up a board position is likely to lead to delay in the student entrepreneurs' education. Therefore, a SDBI should compensate the delay in such a way that students are triggered and eager to participate in its board. The temporality of student entrepreneurs themselves is another continuity challenge. On average academic students finish their education in four to six years (OESO, 2011). This reduces the amount of time a student has for developing his/her company. To prevent that students are caught between their business and education it is important that SDBI management provides them with enough services to maintain the delicate balance.

5.2.2 Dependency issues

A SDBI is not totally independent of its parent university. Therefore, competition over resources within the University will affect the SDBI. Next to that, if the University goes bankrupt or is in financial trouble, this will also influence the SDBI (Trott, et al., 2008). Due to the transience of student boards it is unlikely that the SDBI is able to plan for long term solutions (>5 years) to prepare for and/or absorb such a financial blow. Second, the student entrepreneurs are dependent on the parent University to obtain their degree. If the University decides to increase the workload of students or lower their support for extracurricular activities, such as student entrepreneurship or the managing of an SDBI, we expect the readiness of student entrepreneurs to engage in managing a SDBI, next to their studies and business, will decline.

5.2.3 Board specific issues

Board composition could prove to be a challenge. Especially when there are huge differences in educational background. Many engineers tend to underestimate the influence of marketing on their business activities (Colombo and Piva, 2012), while business students lack technical competencies to fully understand the needs of technically oriented student entrepreneurs. This can cause frictions and undermine the efficiency of the SDBI board.

Another challenge to the SDBI board regards the selection of new tenants. Regular UBIs base selection of new tenants solely on the feasibility of the business plan. Bollingtoft (2012) suggests that bottom up business incubators should select new tenants based on the attitude towards networking and cooperation of the entrepreneur itself. One can wonder whether this selection task is suitable for temporary student board members. They will have little to no experience with selecting suitable candidates.

5.2.4 Legitimacy issues

The personal characteristics of student entrepreneurs, in particular their young age, might influence the perceived legitimacy of both the board of the SDBI as well as the institution itself. It might decrease trustworthiness, because of missing trackrecords of the student board members and increase uncertainty for companies willing to conduct business with the SDBI.

5.2.5 Over-protection issues

Although the SDBI tries to incorporate an outward view for its tenants, it still is a business incubator. This implies that is creates a safe and surrogate environment for new ventures to hatch and be protected. Therefore a SDBI approach does not resolve cushion or remoteness issues.

5.2.6 Ivory tower issues

Ivory Tower issues address issues that arise when academics only surround themselves with academics. As mentioned before, the SDBI tries to lower the ivory tower by incorporating feedback loops from its alumni entrepreneurs and ventures, which are active in the market place. However, these alumni entrepreneurs were academic students once in order to be allowed to the SDBI program. That is why one could argue that Ivory Tower issues remain a risk.

6 Discussion

Shapiro (1982) already identified the importance of disposition to act (personal entrepreneurial characteristics), feasibility of the alternative and availability of resources to turn a (student) entrepreneurs' dream into an actual deed. Due to the focus on the student entrepreneur a SDBI fulfils both a feasible alternative to working for a boss and availability of resources than a regular UBI. The student driven management reduces the gap between management, entrepreneurs and students, as they are all students. Therefore, we believe that due to the focus on the individual student entrepreneur the SDBI is a flexible, less costly and more appropriate way to stimulate academic entrepreneurship.

Further research is needed to validate our assumptions on the appropriateness of SDBI. We now propose four possible hypotheses on student driven business incubation future research can address to uncover the appropriateness of this type of university business incubation.

(1) Hypothese 1:

A SDBI functions as catalyst for academic entrepreneurship in a non-equity based context.

(2) Hypothese 2:

The discontinuity of knowledge and experience can be overcome by a small proportion of top down input of the parent university

(3) Hypothese 3:

Experience based counselling by former student entrepreneurs better suits the needs and expectations of UBI tenants than peer based counselling by third party professionals

(4) Hypothese 4:

The openness of student driven business incubation matches the contemporary fashion of open innovation and therefore increases the probability of process, product and market innovation.

7 Conclusion

In this paper we proposed a Student Driven Business Incubation approach to University Business Incubators. This approach is based on the bottom up management approach by Bollingtoft (2012) and the common University Business Incubator management approach. Its flexible nature, low-cost and focus on the individual makes it more appropriate than a top-down UBI approach for stimulating academic entrepreneurship. SDBI resolves all UBI' management issues; presents a more appropriate management style based on student entrepreneurs' characteristics; provides better alignment of education and entrepreneurship; lowers financial dependency on parent university and reduces Ivory tower issues, but not eliminates them. There are some other issues of SDBI which could be resolved with more research. These are; continuity issues; dependency issues; board specific issues; legitimacy issues and over-protection issues

7.1 Practitioner implications

This preliminary research sheds new light on managing University Business Incubators. If managers want to implement this student driven approach, they should be aware of the challenges that remain. Still, if a student driven approach is implemented and managed correctly this can hugely impact the amount of academic entrepreneurship. It can also save costs for the parent university on their university incubation program.

7.2 Limitations

Due to the limited research on bottom up business incubators and the gap in literature on bottom up University Business Incubators we do not have theoretical evidence of the advantage of our proposed management style. Next to that, our research is based on only two case studies. More thorough case studies are required to test the appropriateness of the student driven business incubator approach.

7.3 Future research

We encourage future researchers to test whether Student Driven Business Incubation increases the chances of survival for new student organizations. Although the student entrepreneurs within the case studies were convinced it did, proof remains yet to be delivered.

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Universities In The Global Marketplace: A Market-Focused Approach For Interaction With Industry

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Abstract

British Higher Education Institutions (HEIs) aspire to be open and accessible to local businesses, particularly SMEs that may not realise the mutual benefits that are on offer. But results are mixed and SME investment in innovation through R&D is very low.

This empirical research into university: small firm collaboration aimed to find out what works for both parties. Mixed methods were used to analyse interactions between SME and the University of Greenwich to ascertain factors affecting the efficiency and effectiveness of business-academic collaboration. A positive association was found between business impact and taxonomy of university attributes.

The report concluded that from the policy perspective, it is wise to assume that although collaboration between universities and small firms is a complex phenomenon, application of a market-segmentation concept would improve collaboration success at one level. Case study evidence supports the complex buy-in of SMEs into the knowledge exchange relationship.

Whilst the research provides empirical evidence to suggest that academic programmes for business should employ a market segmentation concept, the nature of this interchange is highlighted in the case material resulting in the identification of critical factors for success when collaboration with small firms in the knowledge exchange offer.

A National Centre for Universities and Business has been created (led by the Council for Industry and Higher Education (CIHE) to facilitate the sharing of good practice in the UK.

This research will be of interest to international academics and practitioners with an interest in best practice.

Keywords

University-Industry Interaction. Market Segmentation.

1 Introduction

The overall objective of the research is to analyse and compare the methods of collaboration used between firms with less than 50 headcount and various University Knowledge Transfer Programmes.

For the purposes of this dissertation, the definition of collaboration is drawn from Jassawalla & Sashittal (1998, p. 239) who described collaboration as "the coming together of diverse interests and people to achieve a common purpose via interactions, information sharing, and coordination of activities".

The main seminal literature on this topic focused on the case for action, but, despite the level of interest in university-industry collaborative activity, much less research has been conducted into the underlying mechanisms.

Yet theorists, academics, practitioners, and regulators still suggest that universities should support their local, regional and national skills base by working with businesses, including internationally, to improve their economic, social and cultural impact. Figure 1 demonstrates the benefits perceived from university-business collaboration.

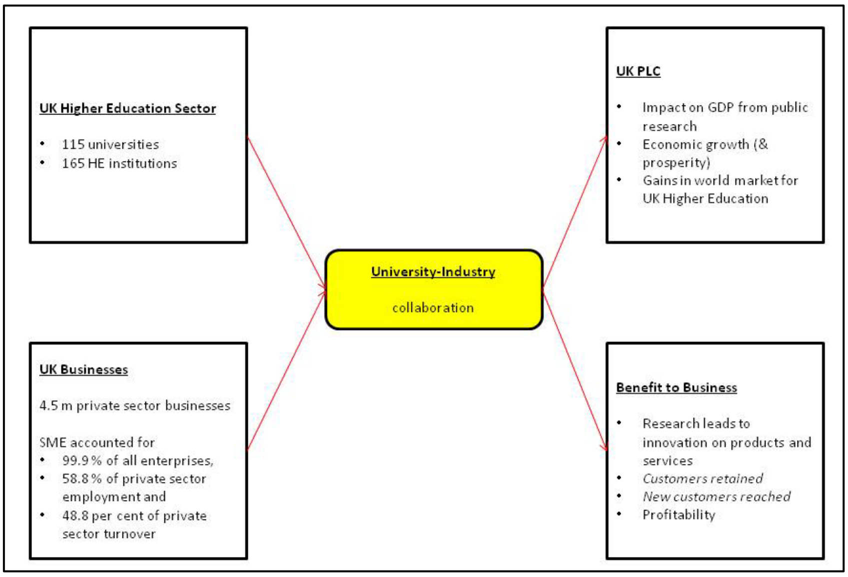

Figure 1 Perceived benefits of university-business collaboration. Source: Author

This paper covers the factors that may affect how effective collaboration has been in case studies between one university and small businesses. It aims to offer a comprehensive examination of the association between these factors and the impact of the collaboration back in the business.

2 Literature review

There are six pieces of seminal contextual literature on the subject of the rationale (why) for university-industry collaboration. The incoming UK Labour Government (elected in 1997) first introduced a specific stream of funding (known as the "third funding stream") to support knowledge transfer in the university sector in England in 1999 following publication of its White Paper "Our Competitive Future, Building the Knowledge-Driven Economy” (DTI, 1999), which responded to the cross-political Dearing Report (1997) commissioned at the end of the 1979-1997 period of conservative governments. Labour’s national economic strategy was built from the premise that

UK's distinctive capabilities were knowledge, skills and creativity, rather than raw materials, land and cheap labour (prior to this report, Walker (1993) had identified that UK was average spender on R&D). The idea behind the "third funding steam" for the Higher Education Sector was to link university research more closely to the goals of national competitiveness, regional economic development and local regeneration, ignoring pleas from academics like Bowie (1994), who identified the risks of university partnerships with business, and similar developments in US higher education sector reported later by the then President of Harvard University (Bok, 2003), who considered that only those institutions that vigorously upheld academic values, even at the cost of a few lucrative ventures, would win public trust and retain the respect of faculty and students.

In 2003, the UK government asked businessman Richard Lambert to identify and clearly articulate the business benefits of more interaction with universities for their knowledge and skills and to assess business-university collaboration across a range of countries and from best practice across the UK. Businesses told him that universities "could be more dynamic in their approach to collaboration" (Lambert, 2003, p. 93). Of direct relevance to the research question, he found that many small businesses had no experience of collaboration with UK universities other than in specialist sectors such as biotechnology and information and communications technology (ICT), although he observed "universities have been forced by economic circumstances to hunt around for new sources of cash and equipment, putting a new emphasis on business partnerships" (Lambert, 2003, p. 83). This was echoed by many scholars' research assessment of widespread concern about the innovation performance of UK industry (Georghiou, 2001), aside from a few leading sectors and firms (Santoro & Chakrabarti, 2002) and larger corporations (probability of collaborating increases with the size of the firm (Hanel & St-Pierre, 2006). Lambert found a strong correlation between business success and university collaboration, but concluded that the best way to encourage this activity was primarily demand-side led, and identified measures that should be put into place to stimulate demand for collaboration. In 2005, Lester (2005) found that the university role in local innovation processes depended on what kind of industrial transformation was occurring in the local economy. A year later, Cox & Taylor's (2006) quantitative and qualitative research in North West England concluded that companies who had interacted with Lancaster University had improved their economic output by £1.4m per annum which, over 10 years, would produce a 8:1 return on investment ratio. On supply side, the Lambert Review recommended that third stream funding should be allocated for three years on the basis of universities' business plans for such activities.

Three years later, a lecture by Allott (2006) at Cambridge University concluded that Lambert was wrong about the linear model for turning academic scientific research into economic growth – instead believing the way to build a strong business / university interface was to get industry to recruit PhD graduates. That year, Peter Warry (Chairman of three major plcs) was invited to look further at the Supply-Side, by a review of how Research Councils could deliver a major increase in the economic impact of their investments (Warry, 2006). In the context of the economy as a whole, Warry also considered competitive advantage for locating in UK neither on labour nor natural resources grounds, but instead on the basis of the skills and business climate that the UK offered. This was consistent with academic research by Mowery & Sampat (2005), who found governments throughout the industrialised world had launched numerous initiatives to link universities to industrial innovation more closely. To that end, he considered the Research Councils had pivotal roles in UK, both as funding bodies and as leaders of the research base and recommended, amongst other things, that Councils ensure economic impact of research be higher profile in their strategies. This signalled policy intent to shift UK research into a more balanced portfolio of pure and applied research.

In the same year, businessman Sandy Leitch (2006) produced an independent review of the UK skills base and a forward-looking analysis which projected the seismic shift in skills demands for UK in the period to 2020 in order to compete. He recommended action by business on intermediary and higher level skills and by government on bringing up the minimum standards across the adult population. "On our current trajectory, the UK’s comparative position will not have improved significantly. In the meantime, the world will have continued to change and the global environment will be even harsher. The scale of the challenge is daunting." (Leitch, 2006, p. 2).

Lord Sainsbury's, examination (2007) of the role that science and innovation could play was commissioned in March 2007. Its term of reference was to enable UK to compete against low-wage, emerging economies such as China and India. This was in the context of government expenditure of 42.6% of national income (the highest share since John Major was conservative Prime Minister in 1994-1995 (Emmerson & Tetlow, 2007)and a rapidly worsening global financial crisis (eg Chancellor's statement to Parliament on 17th September 2007 guaranteeing all the existing deposits in Northern Rock during the period of instability in the financial markets (HMT, 2007). Published on 5th October 2007, Sainsbury's review of the Government’s pre-crisis science and innovation policies provided recommendations covered leadership by the Technology Strategy Board, further stimulation of knowledge transfer, facilitation of science and engineering education, as well as changes to government infrastructure but all aimed at re-structuring British companies into high-value goods, services and industries.

The subsequent 2008 world financial crash (following global share crash in January 2008) and consequential meltdown of capital markets, shook consensus amongst world leaders in respect of the dominant paradigm in economics - the neoclassic theory (which relied on an equilibrium position in all markets (Hodgson, 1992)). As for the higher education sector, the global economic collapse produced even more pressures on the government's education spend. High and persistent unemployment, tightening of international student migration procedures also yielded something not previously seen-the decline of students seeking more education and the acceleration of universities completing internationally for a dwindling student population and resources.

The UK reviews of the rationale for university collaboration with industry that followed the financial crisis focused on competing in a changing context, with debt reduction the new strategic priority. The CBI review (2009) took stock given that pressure on public finances meant changes to the Higher Education funding model. CBI recommended strengthening the environment for partnerships in collaborative research and innovation between universities and business. They placed increased emphasis on research impact - imploring government to ensure that university-business collaboration on research and innovation in a new Research Excellence Framework (HEFCE, 2012), to be implemented from 2014, gave proper recognition to excellent business-relevant research. CBI emphasised that government support for university-business interaction is to improve the knowledge base and increase economic impact and that they should ensure that the Higher Education Innovation Fund (HEIF) continued to help universities meet real business needs. A report commissioned by Higher Education Funding Council for England (PACEC, 2009) reported that 28% of universities now had a strategic plan developed as an inclusive process and accepted by most units, compared with just 6% in 2001.

In November 2009, the UK government published its framework for the future of higher education, given tighter public funding constraints and changes in the global economy (BIS, 2009). This took a fifteen year economic perspective, and articulated the impact of impending changes, some of which were known, and others that needed to be anticipated. "We no longer have the choice in the globalised world to compete on low wages and low skills. We compete on knowledge – its creation, its acquisition, and its transformation into commercially successful uses. Although universities have a much civic, cultural and intellectual role, they are central to this process." (BIS, 2009, p. 3). It heralded key financial policy changes related to university-industry collaboration - more contestability between universities in the Higher Education Funding Council for England (HEFCE) funding regime (in respect to priorities sectors and to Higher Education Innovation Fund); and a new component to the allocation of the research block grant - an explicit impact assessment of past research on the economy and society. It also launched what was later to become profound change in the fees structure for full-time undergraduate students. In December 2010, the new Conservative-Liberal Coalition Government approved the switch away from teaching grants to repayable tuition loans, a £9,000 limit on student tuition fees and their June 2011 White Paper, 'Higher education: students at the heart of the system' (BIS, 2011). A series of radical changes in policy followed, including changes to assessment; university leadership and the nature of academic work; combined academic/administrative roles for employees who are expected to actively engage with business in the community; learner support and a more market focused approach.

This market-liberalisation of higher education was reinforced in December 2011 by the Innovation and Research Strategy for Growth (BIS, 2011), which placed great emphasis on the impact of research on economic growth, launched a series of commercialisation focused technology and innovation centres and foreshadowed a review by the former Vice Chancellor of a university into how to encourage more relationships between universities and business. That review, by Sir Tim Wilson, was published in February 2012 (Wilson, 2012)and concluded that although the eight years since the previous policy review (Lambert, 2003)had seen a huge expansion in collaborative activity, the global reputation of UK universities remained underexploited. When collaboration does occur effectively, it can make a big impact economically - research into the effects of companies collaborating with the University of Copenhagen in 2012 ((DAMVAD, 2012) found strong evidence of a positive causal link between companies entering into R&D collaboration with the University of Copenhagen and the development in productivity per employee for the companies.

A survey of the literature addressing the question why collaborate demonstrates that higher education in UK and globally is operating in a fiercely competitive commercial world and universities should not expect to escape from the turbulence of the rest of the economy. According to Moody’s credit rating and financial forecasting company "As global recessionary trends persist in many nations, universities are proving to be an appealing investment for government stimulus efforts due to the sector’s stabilizing, counter cyclical nature in the short-term, as well as its potential to stimulate long term economic development" (Moody's, 2009, p. 1).

The second dimension of literature reviewed is the "how to collaborate" - the last decade of related academic theory as a base for this research project. This is noteworthy for its paucity.

In 2001, Amabile et al - (2001) conducted a single case study research project of an academic-practitioner research collaboration team at the Harvard Business School Division of Research (between April 1995 and June 1998). Their literary research identified few previous studies and no collaboration theoretical models specifically about academic and management practitioner collaboration. This exploratory study built on what previous scholars had identified to predict generic collaborative success (1) project-relevant skill and knowledge, (2) collaboration skill, and (3) attitudes and motivation. Information was collected through a 38 month period of participant observation, surveys and interviews. Descriptive statistics on quantitative measures were obtained by survey and the qualitative data through study of meeting notes and open-ended survey questions for recurrent themes and apparent causal links. They confirmed the generic predictors of collaborative success and also found two additions that were specific to academic-management practitioner collaboration - environment characteristics and collaboration processes. Their most notable limitation was the reliance on a single case and recommended future research should extend their study using alternative cases.

In 2007, a systematic literature review of Knowledge Transfer between universities and Industry between 1990 and 2004 (Ankrah, 2007) contributed by identifying the 31 factors that were found to have had a positive effect on the perceived success of technology/knowledge transfer – and grouped them into (1) Capacity and Resources; (2) Legal Issues, Institutional Polices and Contractual Mechanisms; (3) Management and Organisational Issues; (4) Issues relating to the Technology; (5) Political Issues; (6) Social Issues; and (7) Other Issues. In 2009, the UK Council for Industry and Higher Education (CIHE) conducted research with partners in the UK, Japan, Canada and the US, where government policy had encouraged the use of university research by business as a driver of economic success. Over 90 case study businesses (33 in UK - 15 were manufacturers and 13 from services sector) were examined to establish the processes of partnership and the process and metrics of knowledge exchange. CIHE (2009) utilised a common semi-structured questionnaire in all four countries. The most frequently found means of initiating company – university contacts which led to successful projects was through the company contacting the university (34%). The most popular modality in each country was collaborative or consortium research in which both the company and university were active in providing intellectual input to a research project (57% overall). Knowledge transfer was achieved by the preparation of formal reports and formal meetings interspersed with informal contacts. Only 24% of all the companies were able to attribute specific revenue or profit lines to a university interaction.

CIHE's conclusions were (a) that successful university-business knowledge exchange should be considered an emergent process, rather than linear - Stokes' Dynamic Model (Stokes, 1997); (b) the relationship between key individuals in the university and company performing the gate keeping function is significant; and (c) the absorptive capacity of the company to translate and embed knowledge created in the interaction is also significant. The latter aspect was later confirmed by Harris et al (2012), who highlight the importance of absorptive capacity in determining the extent to which establishments can benefit from linkages with higher education institutions.

Massachusetts Institute of Technology Sloan Management Review article in Summer of 2010 (Pertuzé, et al., 2010) reported the results of a three year study of 25 US case studies at research-intensive multinational companies.

In May 2011, academic research commissioned by the UK Department for Business, Innovation and Skills interrogated business innovation survey data to establish the distribution of innovation in the UK (Adams, 2011). The analysis of this study showed a wide distribution. On the basis of the analysis, no particular industrial sector or Post Code area absolutely dominated, but it was relevant to this dissertation that one of the areas of low innovation was in the Royal Borough of Greenwich.

In 2009 and then again in 2011, HEFCE commissioned PACEC and the Centre for Business Research at the University of Cambridge to investigate the process of knowledge exchange between academics and external organisations, in light of the £700 million knowledge exchange funding invested in universities by the UK Government between 2000/01 and 2007/8 (PACEC, 2009), (PACEC, 2011). They found a wide variety of mechanisms and much experimentation that all served to diffuse the knowledge and capabilities generated within the HEIs into the economy and society (see Figure 2).

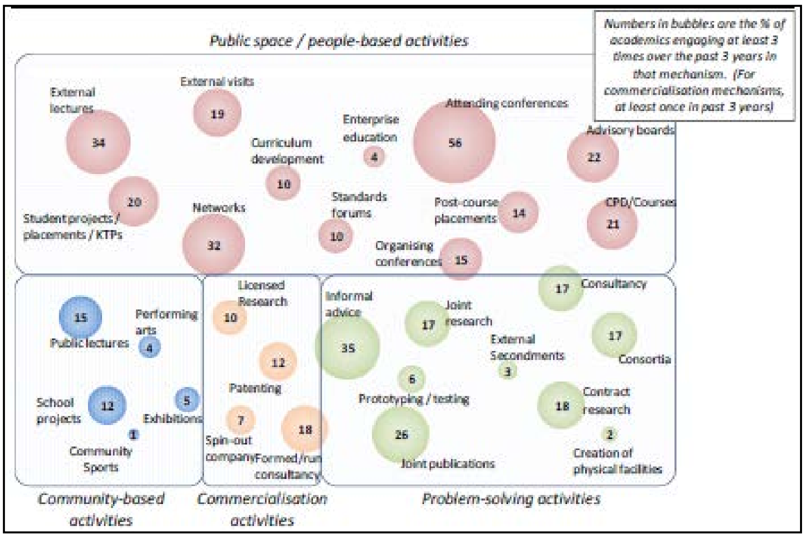

Figure 2 Knowledge Exchange mechanisms. Source PACEC

A survey of the literature demonstrates that the rationale for collaboration - innovation - has attracted considerable interest, building on an economical theoretical perspective. In the second dimension - the method of collaboration - knowledge exchange phenomenon appears to be the area paid most attention by scholars, but very recent analysis for Higher Education Funding Council demonstrates the academic gap.

3 Conceptual framework

After shedding light on the theoretical and literary context for this research, this section aims to set it in a conceptual framework. A conceptual framework is a written or visual presentation that: “explains either graphically, or in narrative form, the main things to be studied – the key factors, concepts or variables - and the presumed relationship among them” (Miles & Huberman, 1994, p. 18).

Given the research objective is to analyse methods of collaboration between small firms and various university programmes (by devising effectiveness criteria and then testing them to determine the influence of each factors in order to develop an explanatory theory), the collaboration success criteria identified in the longitudinal case study by Amabile et al (2001)builds upon from previous academic research. That is (1) collaboration team characteristics (project-relevant skill and knowledge, collaboration skill, and attitudes and motivation); (2) collaboration environment characteristics (3) collaboration processes (interrelated processes of communication, coordination, and cooperation). Critically applied, these factors are linked to three forms of collaborative outcome (phenomena) created by the researcher.

The discrete phenomena and likely relationships, and distinct variables for this research on university - small firm interface for effective collaboration are considered to be as shown in figure 3 - depicted in a model as green boxes. This conceptual framework brings the addition of the concept of ***enablers for collaborative success*** to the theoretical and conceptual understanding of the subject of university-industry collaboration.

PHENOMENA (independent variable)	1. How far the business's objective for collaborating with a university was achieved
	2. How likely the business is to take action from what they heard/learned from the University
	3. Whether the work with the University turned into any impact/consequences for the firm
FACTORS (dependent variables)	1. The extent of the business representatives' experience with working with a University prior to the collaboration
	2. Business view of the extent to which the skills/knowledge of lecturer helped or hindered the experience of working with the university
	3. Business view of the extent to which the communication before and after helped or hindered the experience of working with the university
	4. Business view of the extent to which the environment of the transaction (facilities and other delegates) helped or hindered the experience of working with the university

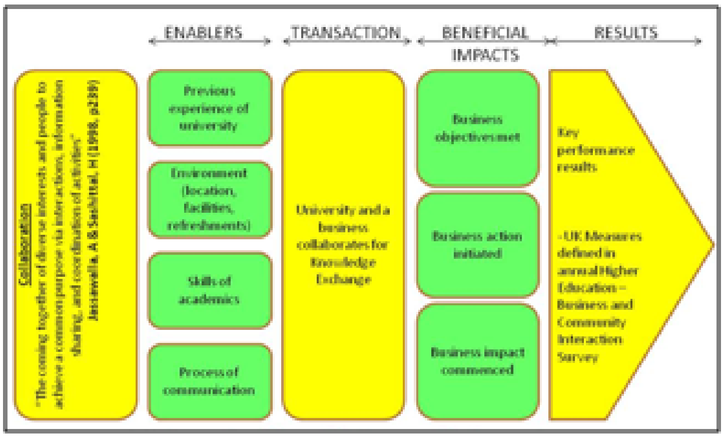

Figure 3 University-Small Firm Conceptual Framework: Source Author

4 Methodology

To study the research question, the overall objective is to analyse and compare the methods of collaboration used between firms with less than 50 headcount and various University Knowledge Transfer Programmes by step by step activity on five sub-objectives.

(1)	To establish suitable effectiveness criteria for a Small Firm -University collaboration.
(2)	To describe the extent to which the effectiveness criteria for a Small Firm -University collaboration have been met in at least four Small Firm-University collaboration projects that have been completed at Greenwich University in the last 3 years.
(3)	To determine the factors associated with the effectiveness criteria for Small Firm-University collaboration.
(4)	To determine whether some of those factors are more influential than others.
(5)	To develop an explanatory theory that associates certain factors with the effectiveness of a Small Firm - University collaboration.

Table 1 Research Objectives

The main objective contains two constituent parts – (a) what works best, and (b) comparing the methods of collaboration. The purpose of seeking data to answering this question is to identify enablers of better outcomes and the potential is to encourage more comparisons within and between universities (scope of results). From a social research philosophy perspective, a "best method of collaboration" suggested an objectivist epistemology (independent of the participants in each collaboration), knowledge about which could be obtained scientifically from a total population of collaborations between University of Greenwich and companies with less than 50 staff by statistical analysis to obtain truth. On the other hand, as the purpose of answering the question is about "enablers of better outcomes", this suggests a value bound, subjective interpretivist epistemology.

The first four sub-objectives of this research suggested a deductive approach, hypothesising relationships according to an existing theory or a set of theories before testing these hypotheses by collecting and analysing data. The fifth sub-objective sought an explanatory theory from the findings –which suggested an inductive approach be applied where data is collected and analysed first, and a theory is developed to rationalise the findings of the data analysis. The conclusion therefore was that a pragmatism ontological focus and adoption of a continuum of both objective and subjective epistemology and deductive and inductive research approaches was pertinent for answering the research question. By sequencing this way, the analysis is more likely to be trustworthy, credible and thereby making conclusions and recommendations compelling.

The pragmatism stance also opened the door to synthesising a quantitative study to gain statistical patterns, with a qualitative interview to determine greater depth knowledge to validate the quantitative analysis. (Webb, et al., 1966, p. 3) observed "once a proposition has been confirmed by two or more independent measurement processes, the uncertainty of its interpretation is greatly reduced". As the purpose of the research was not to project the results of a survey on a larger population — the sample size was not as critical as being balanced and reflective of the population. Summary of methodology and method is in figure 4.

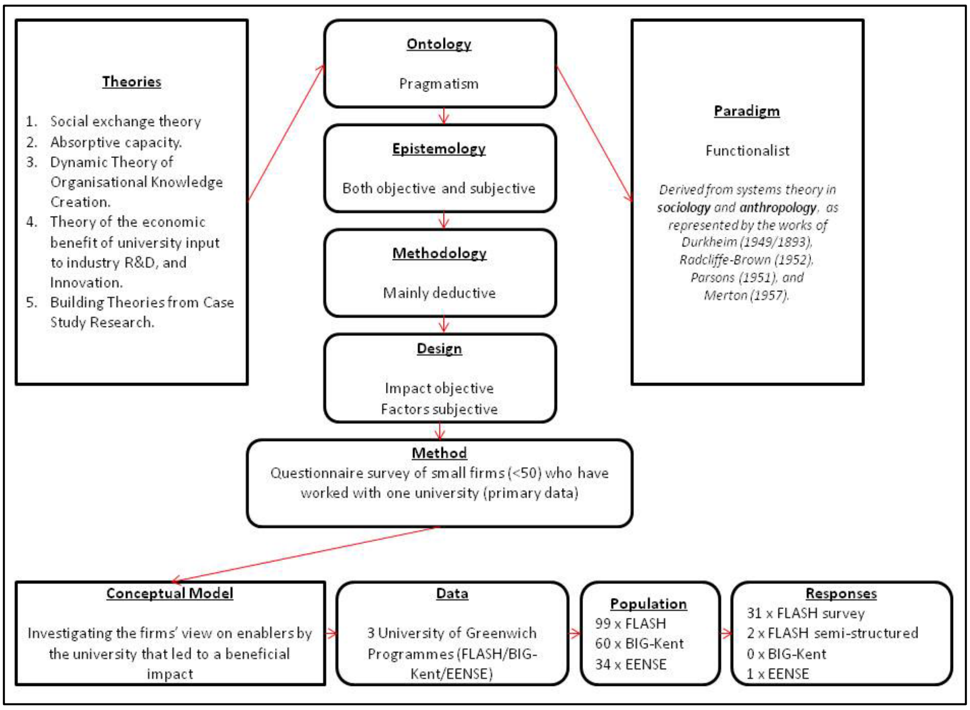

Figure 4 Methodology and Method: Source Author

5 Findings & analysis

The contact details on the 99 Small Firm Business Needs Assessment Forms held in paper format by the Centre for Innovation, Imagination & Inspiration (i3 Centre) at the University of Greenwich. A recent (2010) initiative that is integral to the university's knowledge exchange, research & enterprise and employability strategies, the i3 Centre provides a rolling programme of innovation workshops for businesses. It is physically off campus, but close to the university at a prestige address and is equipped to a very high standard. Led by a Professor of Enterprise and Entrepreneurship, its human resources are high calibre academic practitioners from across the university and beyond who are both research and business- engaged and connected. They teach, research and apply relevant knowledge in the area of Innovation, Enterprise, Entrepreneurship, SME support and Employability and seek opportunities to work with SMEs and encourage them to use undergraduates and each other in research and business development activities. The centre asserts that it inspires its business clients and encourages experimentation with new ideas. Funded programmes incentivise SME engagement and one such programme - the Facilitation, Learning And SHaring (FLASH) Innovation programme (part of the Institute for Sustainability's FLASH project, which is part-funded by the European Regional Development Fund (ERDF)) aims to help London-based SMEs to have access to the information, research findings and best practice they need to seize the commercial opportunities arising from the move towards a low carbon economy. The funder measures success by the number of businesses engaged, the number assisted by collaborating with the Knowledge Base; joining a business network and consequent transactions such as new products, new services, jobs created/saved and increased value (LDA, 2009).

The second population details were drawn from 34 small firm accounts managed by the university and held on an on-line database maintained by the three delivery partners of Enterprise Europe Network South East (EENSE) - Business Support Kent CiC, University of Greenwich and European Information Service Centre Ltd. This is one of the 21 EU-funded programmes in the EU Entrepreneurship and Innovation Programme.

It forms part of the Competitiveness and Innovation Framework Programme 2007-2013 Europa (2006) – which aspires to make the European Union the most competitive and dynamic knowledge-based economy in the world. Enterprise Europe Network asserts that is provides Small and Medium Sized Enterprises with business and innovation support by offering information, feedback and partnership services, innovation, technology and knowledge transfer services. The funder measures success by the number of participants attending events organised by Network partners and consequent transactions such as business/ technology/ research partnership agreements.

The survey questionnaire was issued to 99 small firms collaborating with i3 Centre at the University of Greenwich at the end of May 2012 for completion by the end of June 2012. The same questionnaire was issued to 20 of the 34 small firms collaborating with EENSE at the University of Greenwich at the end of July for completion by the end of August 2012. The average number of employees in the available sample population of 133 small firms was 4.68. The average number of employees in respondent dataset of 32 was 4.32 staff.

Research objective	Finding
To establish suitable effectiveness criteria for a Small Firm -University collaboration.	Three criteria : (a) Small firm's own objectives met; (b) Knowledge used by small firm; and (c) Impact observed by small firm Established from 2001 research on one case and applied to 32 cases.
To describe the extent to which the effectiveness criteria for a Small Firm - University collaboration have been met in at least four Small Firm-University collaboration projects that have been completed at Greenwich University in the last 3 years.	Small Firm's objectives met (in full or in part) in 81% of cases. Example Small Firm quote *"We have managed to focus our business activities in new area to fill the gap we have identified as a result of our involvement with FLASH project"* Owner/Manager of Construction Firm. "Action already taken" was most frequent Small Firm response. Example Small Firm quote *"Working with Chris Birch has been one of the best aspects of being involved with FLASH."* Owner/Manager of Retail Firm. Consequences observed "partially" by Small Firms. Example Small Firm quote "Work is still underway but all in progress" Owner/Manager of Food Services Firm.
To determine the factors associated with the effectiveness criteria for Small Firm-University collaboration. To determine whether some of those factors are more influential than others.	19 of respondents had no previous university experience. Skill of academic mentioned in 39% of responses Pre-post collaboration communications by the university mentioned in 34% of responses. Academic environment mentioned in 19% of responses.

Table 2 Findings against research objectives

The chi-squared test provides a way of finding out how likely it is that the independent and dependent variables are associated. By cross-tabulation, the responses for each independent variable (impact of collaboration) were **chi-square tested separately –** see Figure 5

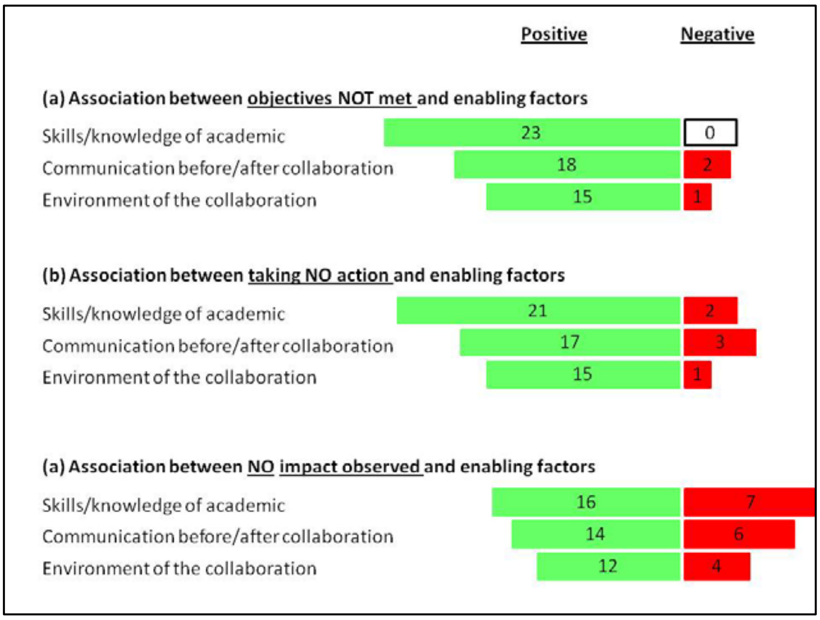

Figure 5 Chi-squared associations

The analysis suggested that **skill of academic and previous university experience have more association with effectiveness** than pre-post collaboration communications by the university or the academic environment. The **least association** appears to be environment.

The objective of this inductive phase of the research process was to develop a contextually grounded, data-driven comparison to the apparent quantitative association between factors and impact, in order to triangulate multiple sources of data (Saunders, et al., 2009, p. 146). The qualitative data collection mechanism of an in-depth interview, to collect 'rich' information, plus data from the open text questions in the thirty-two survey questionnaires following Miles & Huberman's (1984) categorisation and theme analysis. First, quotes were extracted dealing with Small Firm objectives for collaborating with the university. The coding process on the verbatim narratives extracted key words related to skills of academic, pre/post communication and the environment of the transaction. These were consistently mentioned by respondents as both positive and negative effects on the benefit to their Small Firm. This logical pattern was further tested by tag cloud (Hearst & Rosner, 2008), where the frequency that a words appears increases its size (a facility built into the survey software (QuestionPro, 2012).

In terms of the conceptual model, the overall and clear-cut findings are that there is a relationship between firm-level impact variables and enabling factors of academic skill/communications and environment, in collaborations between the i3 Centre at University of Greenwich and Small Firms attending FLASH workshops. Only one (negative) response was received from the 20 small firms in the population for the EENSE Programme (so separate findings, analysis and conclusions were not possible for this programme).

6 Conclusions & recommendations

The overall findings provide support for the general assertion that the skills of the academic and quality of communication before and after each transaction with the university played a significant role in the impact perceived by the firm. Quantitative analysis over 32 cases revealed an association between the three Small Firm impact phenomena (objectives met; intent to take action back in the firm; and impact on firm's results observed) and the three factors that impact collaboration identified in previous research on one case (Amabile, et al., 2001). Moreover, an additional factor was found to associate too which adds to that previous research – that of experience of an university environment. The validity of the quantitative analysis was tested by two types of qualitative method.

This suggests that from the policy perspective, it is wise to assume that although collaboration between universities and small firms is a complex phenomenon, application of a market-segmentation concept would improve collaboration success. The underlying principle is that universities should create productised knowledge exchange offers for small firms. The factors identified in this study are potential facets for differentiated products according to a small firm's previous university experience and capacity to convert knowledge from implicit to explicit. Applied before and during early stages of collaboration would provide the opportunity for the university to target resources and capabilities against each segment to achieve impact. Nurturing relationships can be established with Small Firms with little experience of university ways and with low capacity to convert knowledge to business impact; supportive relationships with those who have some capacity; and implementation relationships with those with most potential.

The final aspect of this research was an objective to develop an explanatory theory that associates certain factors with the effectiveness of a Small Firm -University collaboration. Based on the discussion presented above, the challenge posed by government to ramp up university-industry collaboration is not sufficient on its own. Leveraging academic know-how requires less emphasis on economic aspects and activity and income measurements but instead a strong relational and exchange component and more research conducted in communities of practice. Lynham (2002, p. 228) offered a generic applied theory-building method to "..interact with and be influenced and informed by both her or his experience of the phenomenon in practice and her or his acquired knowledge/mastery of the phenomenon in theory".

Operationalisation phase was empirical research findings which supports that explanation of the dynamics of key phenomena of university-small firm collaboration. However, the findings do not suggest that these attributes on their own are the only factors that play a positive role in achieving collaborative outcomes. But the evidence suggests that these and other factors be the focus for future research to build theory through Lynham phases of confirmation or disconfirmation, application and ongoing refinement and development.

Surprisingly, the large degree of autonomy of universities (Royal Charter) and "arms reach" relationship with bodies and associations that influence on their behalf has seemed to be a barrier to academic applied research and theory building about collaboration best practice in the UK. This gap seems to have finally been addressed, recognised in the appointment of CIHE as the focal point going forward. Accordingly, with regard to answering the main research question, this study concludes that, in general, universities wishing to increase the proportion of successful collaborations with small firms would benefit from establishing in advance (a) the previous university experience and specific objectives and (b) capacity to make knowledge explicit back in the firm by the collaborator. Consequently, economic theory is found to not provide a comprehensive explanation for the relationship between a university and industry and thus applied theory building research to further examine other perspectives such as social exchange theory and Knowledge Exchange theory in understanding this phenomenon is recommended.

7 Managerial implications

The finding in this dissertation research primarily inform managerial practices in universities in this changing environment. Firstly, empirical evidence that academic programmes for business should employ a market segmentation concept, explicitly identifying at the planning stage what factors are critical to success when collaborating with small firms and then use them to productise the knowledge exchange offer, and measure and evaluate. This may encourage the university to find resources to (a) ex-anti prequalify the small firm to match the ambition of the business to its prior experience and absorptive capacity and (b) ex-post account management of the small firm's knowledge exchange so as to ensure that impact on the firm's performance is felt.

The adoption of productised offer/business segmentation model for university-industry collaboration might translate into a taxonomy shown in Figure 6 (references to the FLASH Programme could also be applied more generically).

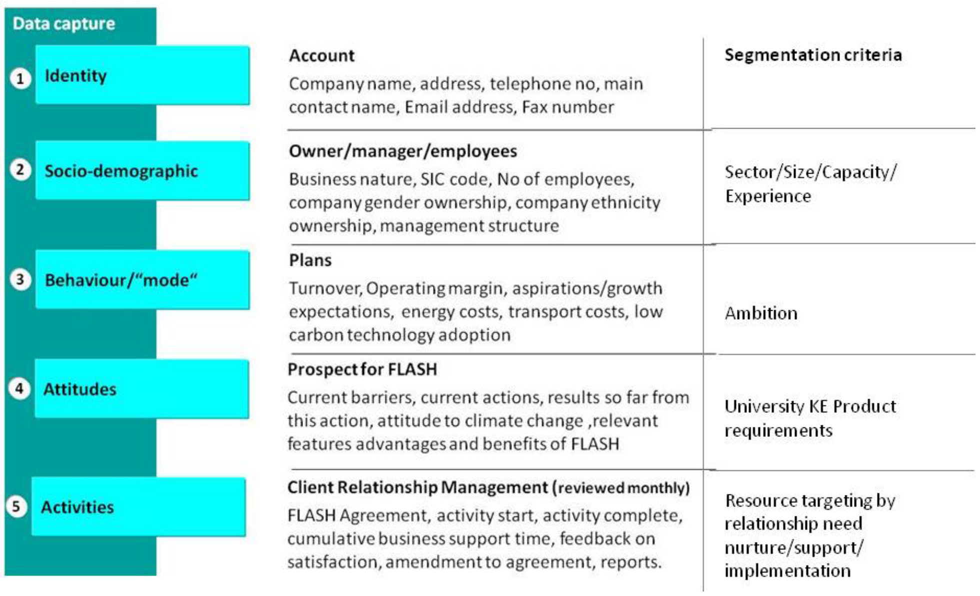

Figure 6: Productise/segmentation taxonomy for FLASH

The management practice of the new sector regulator in the UK (HEFCE) might also be informed by this dissertation research. Universities operate in a global market place for higher education demand and research collaboration partners, yet the UK government investment has no domestic ring-fence (uk-based firms and uk-based research). The economic benefits of university-industry collaboration are global rather than domestic and this might become more prominent as UK universities chase demand from significant growth in middle classes in emerging economies.

In so far as the management implications for small firms are concerned, the main conclusion that is drawn is that managers should make a realistic assessment of their own capacity to make the most of the collaboration with a university. This study shows that this is a pre-qualification for the business to make the most of the investment of their time with an academic. Moreover, those seeking new collaborations would be well advised to pay attention to the universities who attempt to segment their knowledge exchange offers.

8 Limitations

The research objective was to analyse methods of collaboration between small firms and various university programmes. The results should be interpreted in light of several limitations. Although this dissertation studied previous theoretical and empirical works in constructing the model and measuring the variables, the principle limitation of the paper is that it covers a broad base, reviewing and categorising literature that mentions university-industry collaboration and then attempts applied theory building with a limited number of exchange theory related factors and a single UK university. In terms of dependent variables, the survey respondent interpretation of the factor question may mean that other factors had a much greater impact either positively or negatively.

The research assumption in this dissertation was that knowledge being applied back in the small firm would also be what works best for the university. A further limitation was the omission of data collection from the university academic's perspective – their perception of what factors affect success in order to fully address the element of the research question – what works best for both parties.

Lastly, the research objective included a comparison between two schools in the university. Compare and contrast analysis was not possible because access to small firm cases in the School of Engineering was not achieved and all bar one of the 20 candidate small firms in the substitute comparator project (EENSE) did not respond to a very similar survey format to that used in the School of Business.

However, this research does provide a new conceptual model and applied theory pathway for future studies, which might enrich our understanding and provide additional insights to how to models for successful university-industry collaboration.

In this regard, there are a number of areas in which further research might be undertaken to overcome the limitations. Populations that enable comparisons between universities and the extent of segmentation/productisation would gain further insights into the relationship between targeting of university resource and business/economic impact. Finally, whereas social exchange theory was the frame of reference for this study, exploration of other social science disciplines (eg psychology) would lead to different epistemological and methodological considerations.

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Towards Entrepreneurial University Of Applied Sciences

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Abstract

JAMK University of Applied Sciences is located in Central Finland, which is strongly concentrated on forest sector, i.e. papermaking, wood products, forestry and machinery industries. Loss of traditional jobs has faced the region during the last few years and a growing number of new innovations and entrepreneurs is needed.

Since 2011, JAMK has developed a new “JAMK Generator” concept. It combines tools for innovation and entrepreneurship assistance. The most important functions in the Generator are a) Education on Entrepreneurship in study programmes; b) Ideas to Innovations, which helps to evaluate the commercial potential of ideas and the commercialisation; c) Business Incubator, which helps students in developing their own businesses during the studies, and as a part of their studies; and d) Service Factory, which combines the ideas of the representatives of working life with our staff and students for creating new service innovations.

Accordingly, JAMK Generator supports the path from incipient idea to concrete projects, entrepreneurship, patents and licensing. So far, the results have been promising and increasing number of start-up’s but also patents and licencing have been achieved.
Furthermore, we have over 15 years of experience on Team Academy (studies for Bachelor’s Degree Programme), generating impressing results in student entrepreneurship and over 5 years of experience on Entrepreneurship and Business Competence studies (Master’s Degree Programme). We aim to further boost the entrepreneurship and innovations among the students and staff. Our goal is to expand the entrepreneurial education and make it include all the fields of study as well as further increase the number of innovations.

JAMK University of Applied Sciences is also a part of a larger innovation system in the area. The whole innovation system has been evaluated and during 2012 a new model for cooperation, called Jyväskylä Business and Innovation Factory (BIF) was launched. This helps us to work more effectively and economically by developing common service concept with our partners and providing best and equal service to all clients.

Keywords

Entrepreneurial University, Entrepreneurship, Innovation

1 Introduction

The universities of applied sciences and the universities form the Finnish higher education system. There are nowadays 25 universities of applied sciences which operate under the Ministry of Education and Culture. The reason for establishing the universities of applied sciences in early 1990’s became from the needs to develop the national education system. The universities of applied sciences should operate in close contact with working life. The Finnish system has followed the example of e.g. the Dutch and German systems. (Rectors' Conference of Finnish Universities of Applied Sciences, 2013)

Main tasks of the University of Applied Sciences are education, applied research and development and regional development. JAMK offers education in eight fields of study: business administration, culture, health care and social services, natural resources, natural sciences, technology, communication and transport, tourism and hospitality management as well as teacher education. There are altogether 8500 students and 700 staff members at JAMK. The annual turnover exceeds 60 million €. The share of R&D is ca. 15 %.

Central Finland, where JAMK University of Applied Sciences is located, is a province of 270 000 inhabitants. The province is strongly concentrated on forest sector, i.e. papermaking, wood products, forestry and machinery industries. In 2007-2011 the region had a cluster programme with the following clusters: New Generation Machines and Equipment, Dynamic by Bioenergy and Developing Housing (Regional Council Of Central Finland, 2011).

The aim of the clusters has been to help companies grow profitably, speed-up and support creation of business strategies, develop business culture in Central Finland, increase competitiveness of companies and industries and to gain more jobs, prosperity and well-being (Regional Council Of Central Finland, 2011). Remarkable loss of jobs has faced the province in forest, machinery and IT industries during the last few years. That was an essential reason behind the cluster programme and its objectives. JAMK was responsible for one of the cluster programmes, Dynamic by Bioenergy.

In Finland, national innovation programmes have already existed for about 20 years. Also in Jyväskylä, the work connected to Centre of Expertise Programme started in the early 1990's. The main themes included paper manufacturing, energy technology, ICT, nanotechnology and tourism. JAMK has participated actively in the programme by collaborating with several companies mainly in R&D.

From the beginning of 2014, a new national innovation programme called Innovative Cities, will replace the Center of Expertise Programme. The main areas of interest in Jyväskylä are planned to be Bioeconomy, Cyber Security and Wellbeing. (City of Jyväskylä, 2013)

A new model for innovation and business development is also included in the Innovative Cities programme. The main aims of the new programme will be to create new businesses, export and jobs. (City of Jyväskylä, 2013)

In Innovative Cities programme, JAMK is one of the main players together with other educational institutions, local development companies, the City of Jyväskylä and numerous companies and public organisations.

This paper describes the recent development in JAMK in enhancing the innovations and entrepreneurial education. The main instrument for this since 2011 has been the JAMK Generator concept.

2 JAMK as an entrepreneurial university

2.1 JAMK Generator

Innovations and entrepreneurship have always been among the objectives of JAMK. The importance of these has gradually grown and in 2011 JAMK decided to start a project to strongly enhance innovations and entrepreneurship. A wide variety of different entrepreneurial and innovation studies and tools were already applied, but the coherence in operations was not sufficient.

At the same time, new goals were set in the new strategy, according to which JAMK aims to be the most entrepreneurship-oriented university of applied sciences in the country. This means that a) JAMK generates new enterprises and entrepreneurs; b) JAMK provides customer-oriented enterprise and innovation services; and c) internal culture of entrepreneurship should strengthen at JAMK.

The new **"JAMK Generator"** operation principle was created by combining entrepreneurial education and innovation capabilities of the whole university. The new concept now combines the tools for innovation and entrepreneurship assistance, e.g. service factory, business incubator and entrepreneurial education in cooperation with working life (Fig. 1). It is also built to work as an umbrella for all entrepreneurial and innovation activities.

The main idea of the Generator is to assimilate substance knowledge of different fields to business knowledge. JAMK Generator supports the path from incipient idea to concrete projects, entrepreneurship and/or patents and licensing. The operational environment of the Generator is composed around Triple Helix between JAMK, companies and public sector.

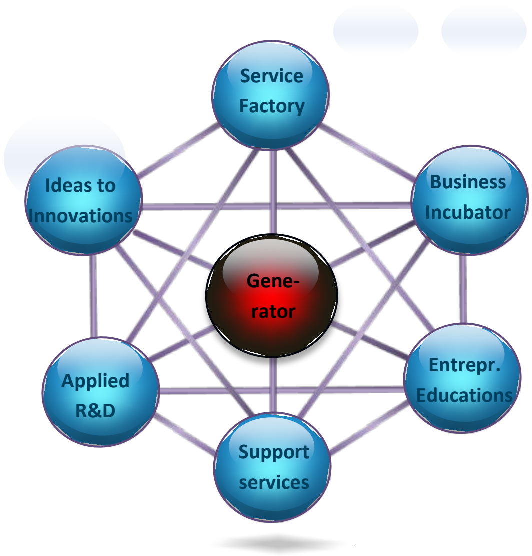

Fig. 1: JAMK Generator and its main functions

2.2 Education on entrepreneurship

Studies aimed at developing basic entrepreneurial skills and entrepreneurial attitudes are available to all students. Students can choose from a total of more than 40 courses aimed at developing entrepreneurship and/or innovation.

JAMK also offers a degree programme in entrepreneurship development leading to a Bachelor of Business Administration degree. The degree programme has been offered by university's Team Academy already for 20 years. In the Team Academy the students start every year altogether 15-20 team companies (cooperatives). The learning happens by doing business with customers, reading books and learning with the team (Team Academy, 2013). The studies are full-time studies that normally take 3, 5 years.

In the year 2012, the projects of Team Academy's team companies reached the turnover of over 2 million euros. In 2012, 39 % of the students were working in their own company when graduating. The percentage grows to 47 % when the survey is repeated after two years of graduating. This is the highest percentage of entrepreneurs within the Finnish higher education institutions. The Team Academy model to learn by doing has spread to 16 places in Europe and one in Brazil (Team Academy, 2013).

Another degree programme with a strong focus on entrepreneurship is the degree progamme in Entrepreneurship and Business Competence, which was established in 2007. This is a 90 cu programme leading to Master's Degree. The programme operates on a part-time basis and the students are working while studying. Therefore the studies usually last from two to three years. As a prerequisite the students must have at least three years of working experience after the Bachelor studies, before they can enter the programme.

Students considering entrepreneurship can also make use of the services provided by Business Incubator. Growth companies are offered Launch Pad and Supercoach® -coaching as a service. (JAMK, 2012)

2.3 Ideas to innovations – Tuli and product track

One goal has continuously been the refining of the ideas from R&D to innovations. This work started systematically almost then years ago in the form of TULI (from research to innovations) programme, which purpose was to refine research-based innovations. TULI-programme was funded by Tekes, the Finnish Funding Agency for Technology and Innovation. TULI helped different research organisations to evaluate the commercial potential of research-based ideas and the commercialisation process (Finnish Funding Agency for Technology and Innovation, 2011).

Based on the TULI project, JAMK developed its own innovation support process for promoting the innovation activities. The process includes the phases of activation, initial evaluation, evaluation, refinement and proof of concept (Fig. 2).

After the TULI project, JAMK has used the Product Track service, which is offered by the Foundation for Finnish Inventions. Product Track is meant for both the students and the staff members. The most promising ideas and inventions are first processed in the university's own process and can then be transferred to the Product Track service.

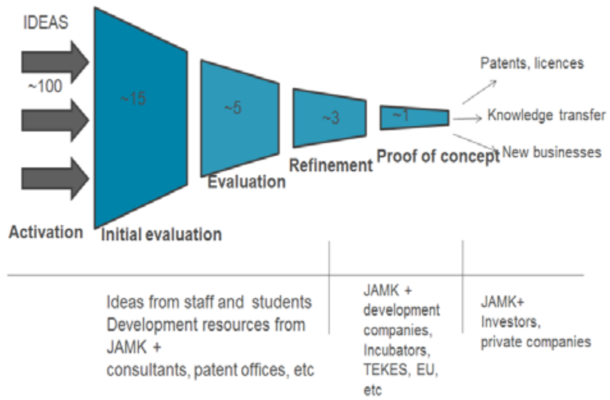

Fig. 2. Innovation support process used by JAMK University of Applied Sciences

Product Track is a national expert service of the Foundation for Finnish Inventions. It provides advice and support for the development of innovations. The inventions and innovative ideas of both private people and start-up companies are evaluated. The goal is to find promising ideas and inventions with potential for growth and international business. (Foundation for Finnish Inventions, 2013)

Product Track is divided into two phases: initial evaluation and development. The initial evaluation clarifies if inventions and ideas can be turned into a profitable business and provides the inventors with recommendations on how to proceed. Some of the inventions reach the development phase and are evaluated in more detail. It is ensured that they are suitable for development and possibilities for commercialisation exist. They are then developed further together with the inventor. (Foundation for Finnish Inventions, 2013)

Product Track follows quite closely the process described in Fig. 2.

2.4 Business incubator

JAMK's Business Incubator has been part of the university's services for the students and nowadays also for the staff. By participating in the Business Incubator's activities, students can get credits for their degree. During the last two years the Business Incubator has operated under the Generator umbrella.

The participation in the activities of the Business Incubator can last from two months to two years, depending on the interests of the participants. The credit units received can vary from 3 to 60.

The Business Incubator offers the following services: a) Persons with a business idea or those acquiring or inheriting a company are offered a coaching process tailored to the business concept in question; b) Entrepreneurs are provided with coaching for growth entrepreneurship and c) Persons interested in entrepreneurship, but who do not yet have a business idea are offered an idea and a coaching process (JAMK, 2012). One example of a student's path to entrepreneurship in Business Incubator is shown in Fig. 3.

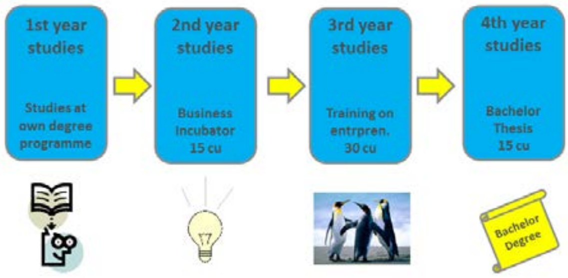

Fig 3. Example of student's path to entrepreneurship in Business Incubator

Setting up of businesses is also supported with advisory services (such as financial and legal advice), services of regional networks and product development and venture capital funding (JAMK, 2012).

The Business Incubator concept in JAMK is under evaluation and reconstruction and a new, developed concept will be launched later this year.

2.5 Service factory

Service Factory is also quite a new concept that is still under development. The project on developing the Service Factory started at the beginning of 2013. The aim is to find new ways for cooperation, where experts from the businesses, JAMK staff and students all work together to develop services, innovation and business. The Service Factory will be developed especially for SME's.

In Service Factory JAMK will develop user-centered methods and processes as well as environment and spaces, which will support the cooperation. The core of Service Factory is the active role of all participants and learning by doing. The participants from the businesses can utilise the premises as an open innovation environment for productization of services and creating of new partnerships.

For SME's, the multidisciplinary expert groups and student teams enable efficient way of generating innovations. Students will get closer look at the working life during their studies and experience a different kind of learning environment. The understanding on product development and innovation projects in general will increase both among the staff and students. We also expect growing number of start-up's as a result.

2.6 Main results

The results concerning the promotion of entrepreneurship and innovation are monitored using e.g. the following indicators:

- Number of Bachelor and Master degrees
- The number of ideas considered
- Commercialised innovations
- New enterprises based on the results of R&D activities (JAMK as part-owner)
- Commercialised ideas
- Patent applications
- Annual revenue (in euros) generated by commercialised ideas
- Credits awarded in Business Incubator
- Number of enterprises established in Business Incubator
- Number of enterprises coached to growth in
- Business Incubator
- Number of students in Business Incubator
- New enterprises originating in Team Academy
- Proportion of entrepreneurs at graduation

Some of the main results from 2010 – 2012 can be seen from Table 1.

	2010	2011	2012
Number of degrees, Bachelor / Master in entrepreneurial degree programmes	56/13	53/18	58/29
New ideas	35	42	97
Ideas in innovation process	10	10	9
Commercialized ideas	4	2	0
Credits awarded in Business Incubator	180	460	510
Number of enterprises coached in Business Incubator	3	12	14
Number of start-up's in Business Incubator	2	14	15
Number of start-up's in Team Academy	3	9	7
Number of start-up's from R&D activities	0	2	2
Proportion of entrepreneurs at graduation	4 %	4 %	6 %

Table 1. Main result on entrepreneurial and innovation activities

As can be seen from Table 1, the start of the Generator at the beginning of 2010 has in many indicators affected in a positive way. Especially the number of start-up's and proportion of entrepreneurs at graduation seem to rise rapidly. Commercialised ideas (from university to the companies) have lowered and probably been replaced by student's or staff's start-up's. However, the period of three years is too short to make any final conclusions.

2.7 JYVÄSKYLÄ Business and Innovation Factory (BIF)

Developing new businesses and innovations is a goal of many organisations in Jyväskylä region. Potential entrepreneurs are not always aware of the best paths from an idea to a successful business. Therefore, a few of the most important organisations decided to join the forces in order to develop a common service concept and provide the best and equal service to all clients.

The main clients of BIF are students, post graduate students and researchers of universities as well as any other persons interested in establishing or developing their own business.

The founder organisations of the BIF are Jyväskylä Regional Development Company Jykes Ltd, Jyväskylä Innovation Ltd, JAMK University of Applied Sciences, University of Jyväskylä, Finnish Enterprise Agencies and Jyväskylä Business Incubator, operated by Suomen Yrityskehitys Oy.

All of the above-mentioned organisations previously had more or less their own approach in entrepreneurial education, innovation generation, business development and incubation. Simultaneously with the foundation of the BIF a common service concept was planned and service tools were chosen. The roles and the responsibilities of each organisation will be further clarified in the near future.

BIF is a new concept in Jyväskylä region. The target is to engage roughly 1000 persons to enter the service annually. Expected results are to create significant number of start-up companies and 10 – 15 growth enterprises annually.

Other important targets of BIF are to speed up the process from an idea to a new company, offer better service to clients and develop a better customer orientated concept. As a secondary objective, this will result in a more efficient and cost-effective process.

2.8 Future plans – towards the entrepreneurial university

Nowadays, students and staff members recognise the potential of entrepreneurship and innovation and the number of ideas generated as part of the activities has grown. However, commercialisation is still in its initial stages. The number of enterprises established by students is growing fairly rapidly but new businesses based on the results of R&D activities are set up at a slower rate.

According to an evaluation made in the students' self-evaluation workshop, students are strongly encouraged to become entrepreneurs. Students interested in entrepreneurship also find the entrepreneurial studies. Students are of the view that entrepreneurship should be seen in a wider context as a way of thinking, not only as an activity aimed at setting up an enterprise. Participants of the self-evaluation workshop also expressed the hope that the services were located in a single place (JAMK, 2012).

According to the students (JAMK, 2012), practical entrepreneurship involving a cooperative, such as the cooperative established to run a restaurant, provides the best learning experience in entrepreneurship. Students would also like to increase multiprofessional work aimed at promoting entrepreneurship.

Promotion of entrepreneurship is in the near future part of the curricula in all JAMK's degree programmes. Students can participate in modes of study supporting entrepreneurship. There are plenty of services and support activities available for promoting entrepreneurship. In fact, there may be too many of them. Entrepreneurship is seen as enhancing JAMK's image. The Team Academy is widely known. There are lots of positive things going on at JAMK and the number of new entrepreneurs has grown.

Another thing is to strengthen the work which was started a few years ago in the form of TULI (from idea to innovations) project. We cannot, however, only concentrate on the R&D-based innovations, which often require a long time and a substantial R&D funding. We also want to develop service innovations. Therefore the work done in Service Factory will be of great importance.

There is a need for our own actions but also for cooperation with other actors. The whole local system will be developed together with University of Jyväskylä, Jyväskylä

Innovation Ltd and Jyväskylä Regional Development Company Jykes Ltd and local companies under the name Jyväskylä Business and Innovation Factory (BIF).

There is also room for improvement in the manner in which entrepreneurship is measured. The measurements are of quantitative, not qualitative nature, and it is difficult to measure internal entrepreneurship. (JAMK, 2012)

3 Conclusions and recommendations

JAMK University of Applied Sciences is located in Central Finland, which has concentrated strongly on traditional forest sector industries. However, loss of traditional jobs requires a growing number of new innovations and entrepreneurs. At the same time, though, the labour needs of present companies have to be fulfilled.

The goal of JAMK is to expand the entrepreneurial education and make it include all the fields of study. Furthermore, JAMK seeks to increase the number of innovations, generated both within the university and together with the companies.

Since 2011 JAMK has developed a new "JAMK Generator" concept to better achieve the strategic goals. The idea is to combine the entrepreneurial education and innovation capabilities of the whole university rather than create a new unit responsible for all this. At the moment, strong development is going on and many things are developed simultaneously. Later on, the most relevant methods and concepts have to be chosen and strengthened.

Changing the university's role from educating the "job takers" to "job makers" is neither easy nor fast. The change in attitudes and mindset requires a long time. Additionally, new skills are needed among the staff members. Moreover, new kind of staff members, with experience on entrepreneurship and coaching to entrepreneurship are needed before we can expect remarkable results. Naturally, concepts such as the Team Academy and Business Incubator have been in the forefront in making the change.

JAMK has to take into account the existing working life and its labour needs. The majority of the graduates are naturally still employed by the local employers. The share of entrepreneurs is expected to rise from 4 % in 2010 and 6 % in 2012 to 10 % in 2020. We also educate people to public sector, e.g. nurses and we have to remember that the healthcare sector might not need so many entrepreneurs. However, it certainly needs new innovations.

Many organisations in the area are playing on the same field, and it requires some time to agree on the roles and cooperation. This is in good progress and the other organisations can help us to achieve the goals. It is not reasonable to make everything alone, but to join the forces to offer together the best service for prospective and existing entrepreneurs. This is in good progress in Jyväskylä Business and Innovation Factory (BIF).

Although we cannot make any final conclusions on the effectiveness of the new Generator concept, we have statistics that show some progress. Especially the number of start-up's and proportion of entrepreneurs at graduation seem to rise rapidly. We also believe, that by continuing systematic development we can continue to move towards the entrepreneurial University of Applied Sciences.

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Towards A Shared Mission

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Abstract
A mission shared by stakeholders, management and employees is a prerequisite for an engaging dialog about the many and substantial changes and challenges currently facing universities. Too often this essential dialog reveals mistrust and misunderstandings about the role and outcome of the universities. The sad result is that the dialog about university development, resources, leadership, governance etc. too often ends up in rather fruitless discussions and sometimes even mutual suspicion. This paper argues for having a dialog involving both internal and external stakeholders agreeing on a shared mission aiming at value creation (in the broadest interpretation). One important aspect of choosing value as the cornerstone of the mission of universities is to stress that the outcome is measured by external stakeholders and by their standards.

Most of the paper is devoted to discussing value in the context of universities. Although the economic aspects of value are important and cannot be ignored, we argue for a much richer interpretation of value that captures the many and varied results from universities.

A shared mission is a prerequisite for university management and leadership. It makes it possible to lead through processes that engage and excite while creating transparency and accountability.

The paper will be illustrated with examples from Denmark and the Helios initiative taken by the Danish Academy of Technical Sciences (ATV) under the headline "The value creating university – courage to do more". As an illustration we use the mission statement of the IT University of Copenhagen that has value creation as a key component.

Keywords
Shared mission, research management, university leadership and value creation.

1 Introduction

Universities are currently undergoing major changes not least to handle the globalisation, but also because of increasing expectations from society that the universities contribute to addressing mega-challenges such as water supply, energy, health, and aging populations. An open, frank and constructive dialog between stakeholders/society and the universities (all levels of management and employees) is essential for addressing the changes. However, for such a dialog to be fruitful it requires a shared view on the fundamental mission of a university. Far too often lack of such a shared mission hampers a constructive dialog and may even create distrust and mutual suspicion. It is not too surprising that the dialog fails if one part expects the universities to create new jobs on a short time-scale and others think that maintenance and interpretation of culture are the main tasks of universities.

A shared mission is an essential part of leading and managing a university. It is the foundation of the agreement with external stakeholders about the overall purpose and direction of the university. It is also the platform for all internal communication and the ultimate yardstick for key strategic decisions. It is our claim that too much energy is wasted both internally and in discussions with external stakeholders when such a shared mission has not been established.

Many stakeholders turn to universities to seek for solutions, jobs, growth etc. It is, therefore, important that universities can respond to this. The reponses given in these years by universities, in terms of innovation especially will significantly shape the future. However, a wider, more complex/rich and shared role of universities' capacities to create value is a more viable and sustainable way to address the challenges faced by society than single targeted initiatiives to create jobs next year, or innovation next month.

The authors have over the past years participated in a Danish effort to make “value creation” a cornerstone of the mission of (Danish) universities. This effort is gaining momentum and supported both by the Danish Academy of the Technical Sciences ATV (ATV 2012), The Danish Council for Research Policy (DSR 2011) and has been discussed at a series of meetings and conferences.

Section II develops the idea of a shared mission based on value creation. However, this immediately poses the question of what is meant by value. This is addressed in section III. In section IV we discuss the importance of people in the value chains. Section V has some reflections on the time scale on which value surfaces. Finally, section VI discusses leadership and management practises supporting a shared mission focusing on value creation.

2 A mission based on value creation

It is proposed to let “value creation” be a key concept in the mission of universities. In this section we discuss key aspects of such value creation and some key properties of “value”. The intention is not that all universities should have the same mission. Value used to characterise what is created at universities allows for a very broad range of interpretations. What we do propose is to have a close dialog both externally and internally about what aspects of value (determined by external standards) that are the most important for a particular university, whether it is a large public institution or a smaller and more focused organisation.

There are, however, some important aspects of value that we find important to stress. First and foremost *value must primarily be judged by external standards.* Whether one talk about the value created by graduates or the impact of research this can not only be judged by internal standards.

In our work in ATV/Helios we distinguish between three value chains: education, research and knowledge exchange. Each of these may of course be subdivided e.g. into undergraduate and graduate knowledge exchange, illustrated in Figure 1. The knowledge exchange chain involves activities like research based support for public services, innovation, entrepreneurship etc. Please note that all three are bidirectional. Take for example the value chain for research, research challenges existing knowledge, policies and practices, however, it is also inspired by outside challenges ranging from mega-challenges as climate change to more narrow challenges like fighting a particular disease or understanding a new cultural phenomenon.

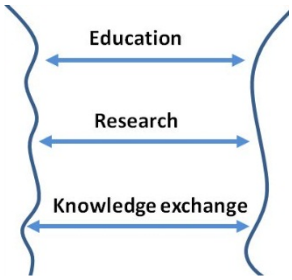

Fig. 1: The three value chains

Despite the bidirectional nature of the three value chains they all produce some output (graduates, publications, new services etc.) which ultimately is what determines the overall value. This focus on output is a cornerstone of the “value creating university”. Too often political discussions about universities focus is on the input not least how much money should be allocated to a university or how many students to admit, how large research grants have been obtained or what people are employed. These aspects are of course important for a successful university, but the interesting judgements must in our view be based on “what comes out of it”. The dialog with stakeholders on output is the basis of creating mutual trust, transparency and responsible use of resources. The term *scientific social responsibility* has been coined as a term characterising this (Krogsgaard-Larsen, Thostrup, and Besenbacher 2011).

To summarize the main points of this section:

- › value creation serves as a basis for a dialog on a shared mission
- › value is judged by external standards
- › focus on the output

In the next section, we will discuss in more detail what “value” could be. Some may think of this only as ”economic value”, however, we believe it is important to use a much richer interpretation. There is no doubt that universities create substantial economic values. As an example, economists have estimated the additional contribution of university graduates to BNP compared to employees with types of education. For Danish graduates this amounts to around 53.000 Euro per year (Junge 2010). OECD has estimated similar numbers for other countries. However, if one only interpreted value as economic value one would miss a large part of the value creation of universities.

3 Value creation

In this section, we will reflect on a number of key aspects of value as used when talking about ”the value creating university”. A key part of this is to try to capture the richness and versatility of value ranging from new insight challenging political or cultural bastions to stimulating economic growth in a developing country through education.

3.1 Examples of values

To illustrate the variety of value we give a number of examples of value creation from the IT University of Copenhagen which has a mission statement containing the phrase "… making Denmark exceptionally good at creating value with IT". Examples of value creation from the IT University:

- *graduates* (as mentioned above each contributes with around 53.000 Euro to BNP each year)
- contribution to *public debate* (a research project on e-voting has stirred up substantial public debate about the potentials and risks to democracy)
- new standard for *requirement specifications* (a research project resulting on a method for writing requirement specifications for public IT-systems has led to significant improvements both in quality of products and reduction of costs).
- *start-ups* (a number of new companies have been started by faculty, ph.d. graduates and students)
- providing *access to global network* of researchers (through an active research group it is possible to establish personal contacts with almost any other researcher in the world – there are examples where companies have been able to get very quick access to research on a global scale and also in areas other than the ones of the local research group)
- *publications* (publishing papers in internationally recognized channels is important for many reasons; first and foremost the peer-review process is a delicate quality control (although not flawless); secondly, it is the entrance ticket to important dialog and feedback though publication, and it is of course an important channel to get the research results spread and become used)

- *history and culture* (even for a young field as IT there is significant value in recording and interpreting its history)
- *providing access to unique infrastructure* (for IT this is both unique technology such as super-/special purpose computers and “big data”)
- *participation* in committees, commissions, and advisory boards (researchers contribute to numerous committees etc. advising both central/local government and private organisations)
- *dissemination* of new research (both written and electronic media use researchers to explain and interpret research results and trends)

Although each of the examples given in the above list illustrates an important example of value creation, the most important thing to note about the list is the mutual interdependence of all the items on the list. Graduates are a very important channel for spreading new research, and they are also important for channelling feedback and new challenges back into the university. Creating and disseminating research results e.g. the new standard for requirement specification (mentioned above) is at the same time valuable in itself (because it leads to creation of better IT solutions), but using the results is also an important source of inspiration for new research. This *interdependence of all the items on the list is probably the most important value of a university*, namely that the integration all the above ways of creating value and numerous others into an indispensable ecosystem.

Universities are "the top if the ice berg" in our public educational system. They disseminate, generate and consolidate knodlege which is used in high-schools and primary schools via the training of teachers. Thus universities play a significant role in education, also for those who do not attend university.

3.2 Integration of value chains

The three value chains mentioned above are an abstraction that gives a simple platform that may be used as a first approximation. There are many examples of high quality education provided by other institutions than universities. Similarly, excellent research is done in industrial labs, museums, hospitals etc. *The unique value of a university is that it integrates multiple value chains* enabling students to get involved in research, education and research to influence each other, challenging and be challenged by developments in society and so on.

It is important to maintain a balance between the different value chains in order to preserve the delicate integration that we claim is the special and most important aspect of universities. Of course each university should find out what is their mix in a close dialog with their key stakeholders. However, allowing one of the value chains to completely dominate the others will in the long term harm the most important value creation aspect of universities namely the interplay and mutual inspiration from integrating the value chains.

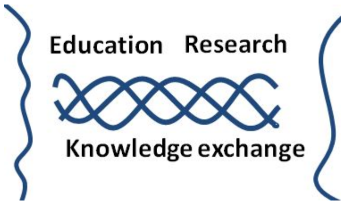

Fig. 2: Integrating the value chains

3.3 Unlocking value

The integrated nature of the value chains has a potential danger of making them invisible or at least less visible than they deserve. They may not be visible at a quick glance from the outside, there is considerable tacit knowledge, and internally there may not be enough focus on exposing them. It may, for example, happen that graduates who come to a new job with updated knowledge that is not exploited. This means that the value is not unlocked. Similarly, the value of new research challenging existing practices, culture or policies is only unlocked if the researchers are in close dialog with those who are challenged. Since change is not always welcome and easy, there are of course numerous ways such a dialog may be hampered. Like money in a bank account the value is really symbolic until it is used for something one wants to achieve or acquire.

Unlocking the values of universities is a joint responsibility of the universities themselves and their external stakeholders, and trustful, open and constructive dialog is a key instrument.

3.4 Methaphores

One may wonder what could be a good metaphor for a university illustrating the diversity of the value creation while stressing its integrated nature. Could a coral reef be such a metaphor?

A coral reef is beautiful; it is one of the most extraordinary creations of the sea, vulnerable, created over a very long period of time and easy to destroy. One may sometimes get the impression that some believe that universities should be handled like the coral reefs. However, in our view this is not a suitable metaphor, because it does not provide a good platform for discussing the question of how universities handle the many and deep changes that is currently challenging them.

We believe that a sea or ocean is a better metaphor because a sea is at the same time provides a wide range of qualities such as:

› beauty

› food

› threats

- transportation
- variety

At the same time, the sea is indispensable and its value is not apparent at a first glance. Similarly to the university, all the value chain form an integrated whole, where one cannot get the food without also accepting the threats of storms. Like the university, judging the value chains of the sea is complex and best done externally.

3.5 Value indicators

A logical consequence of the integrated nature of the value creation from universities is that it cannot be measured by a single or very simplistic yardstick. In particular, short-term financial result is not a good measure. The output of universities does have a significant economic value like the contribution to BNP by graduates, to job creation through collaborative projects/start-ups, through new products and services. However, there are many more dimensions of the value creation like maintaining and interpreting history and culture, dissemination of research, and enriching society with a knowledge base for policy making, regulation and the public debate in general.

There are numerous indicators for evaluating various aspects of the output from universities like citation indices, accreditations, awards/prices etc. But just like the sea, it is important not to reduce the estimation of value to a single indicator. The real value of a university as well as the sea is the integrated eco-system from which different stakeholders may extract various valuable outcomes.

Despite the multidimensional nature of the value of universities there is maybe one common denominator on all or most of the many dimensions.

- *graduates* from a university are particularly valuable when they use what they have learned to *challenge existing practises*
- *research that challenges the existing* is indispensable for developing our societies whether the challenge is to science itself or to existing perceptions
- *challenging predominant political views, norms or prejudices* has always been an important role of universities

The common denominator in these and most other of the values coming from a university is: *challenge*. The stronger the challenge the more important/valuable the contribution may be. One may take a step more and claim that the more dimensions that are challenged the more value it may create. For example, the chance of research having substantial impact is reduced if it only addresses one or a few aspects of a challenge.

Conversely, the universities are also constantly challenged by society. It is expected to contribute to addressing mega-challenges like climate, aging, water shortage and new cultural phenomena.

This duality of challenges is at the heart of the value chains linking universities to the society at large.

4 Value is realized through people

Like the sea, the value of a university is not immediately visible. It is realized in the interplay with the surroundings and most often through people. For example, when graduates use what they have learned in the jobs they get after graduation. This can take many forms e.g. contributing to new products or services, but also in more indirect ways by challenging established attitudes, viewpoints and practises.

The value creation from research is also most often realized through people. For example, in collaborations between industry and researchers where research is informed and inspired by real world challenges and where research based knowledge is used to develop existing products, practices and services in a company, a museum, a hospital, a school, public administration or numerous other places where challenges require new approaches and change.

In a recent study made by Harvard Business School it was documented that a funding scheme encouraging public private partnership established to foster transformation of research into commercial applications creates significant economic growth and job creation (Chai and Sheh 2013). The study focused on projects supporting high technology areas and reported decreases in the likelihood of bankruptcy and increases the average level of employment in companies participating in the supported joint research projects. Although the study focused on high technology areas we believe that the conclusions to be more general. A significant part of the value creation in the projects studied stem from the fact that these projects also integrate a number of value chains. Although not directly supported by the grants many students get involved, get access to the research frontier and participate in the networking. Most often the projects lead to dissemination efforts, interviews in the media etc. We believe that such tightly integrated value chains will be the result of most projects where a number of partners get together to address significant challenges, no matter in what field or sector.

There are examples where research can be packaged as a product and “sold” without much interaction between researchers and those that apply the research and hence do not lead to much interaction. However, this is the exception; in most cases close human interaction is needed for the value creation. This is why the distinction between fundamental and applied research seldom is very useful. *The value of research is meeting challenges and not in its distance from practice*. Dialog is almost always needed to understand the true nature of these challenges.

5 Time scale for value creation

The timescale with which new insight is turned into changes can differ substantially and is seldom a good indicator of value. Hans Christian Ørsted discovered electromagnetism in 1820; this is an important foundation of many of today's technologies including electric motors, mobile phones, computers and windmills – a time span of almost 200 years. Conversely, the discovery by Marshalls and Warren (Marshall and Warren 1983) in 1982 that ulcer is caused by the Helicobacter pylori bacteria revolutionized medical practice in a few years. In both cases the insight provided by the discoveries was inspired by a desire to understand that were important challenges both to external stakeholdes and to the research community – and this is what makes them valuable.

Universities have a key role in collecting, maintaining and interpreting research accumulated over long periods of time. Quite often insight is reinterpreted several times as society develops. For example, the economic theories of Karl Marx have had a very different status over the past 150 years. Good research will often challenge society, its norms and what is considered obvious. A close dialog between universities and stakeholders is again a key to realizing the value. The insight provided by research (both old and more recent) is embedded in graduates who challenge society by transforming the insight into change and development.

As with the sea the value creation of universities must be assessed on a long time scale. Underneath the surface can be a coral reef which is unique, created over hundreds of years and only accessible by a few with special resources. At the same time the sea provides food to many on a daily basis – and may do indefinitely if care is taken to preserve the delicate balance of its eco-system.

6 Value stimulating leadership

Agreeing on a shared mission is a first but very important step towards universities delivering valuable results. However, a shared mission is not sufficient. It is also necessary to develop leadership and management that strengthen the value chains, ensure a proper balance between them and ensures excitement about the mission both internally and externally.

University and research management is a frequently debated issue, there are even voices claiming that it is harmful. In our view, *leadership is about enabling an organization to create results* beyond what could have been created by the same people individually (without an organisation). There are unfortunately examples of harmful attempts to manage and lead. However, this should not be used to prevent the creation of successful organisations with leadership creating extraordinary results (value).

Very often the debate about university leadership is not really about the need for or qualities of leadership and management in itself; but a disagreement about the mission.

If there is widespread disagreement about the mission then there is no platform on which to lead. We believe *that finding a shared mission that creates excitement both internally and from external stakeholders is a first and absolutely necessary step to make it possible to lead* and manage a university and hence to deliver extraordinary value/results.

With agreement about a shared mission from external stakeholders, not least the "owners" which for public universities is local or central government, it becomes possible to agree on framework conditions that fulfil the "owners" legitimate expectations to results, use of resources, and direction without introducing detailed rules and regulations constraining education and research (as it is unfortunately often the case otherwise). This transparency and accountability is a cornerstone of the "value creating university".

Examples of such framework conditions encouraging value creation are:

› focus on output and goals

› avoiding detailed regulation of internal processes

› focus on activities unlocking the values created

› defining major societal challenges requiring involvement from universities

› ambition and patience.

7 Conclusions and recommendations

The value of a university is an integrated whole where a number of individual contributions stimulate and develop each other. In the big picture there are three value chains: education, research and knowledge exchange. Each of these may exist separately and there are many examples of excellent research or education done outside universities, however, *the unique aspect of a university is that integrates the three and all their subparts into a whole.*

Dialog and addressing challenges are key aspects of the value creation of universities. Dialog is necessary for transforming insight into value and for addressing challenges; whether it is the universities that challenge society with new insight or society that challenge universities to get involved in meeting challenges. These years, some of these challenges are global and important to all universities e.g. challenges related to energy, health, water, and aging. One of the results of such a dialog should be agreement on a shared mission.

The most important aspect of finding a mission shared by external stakeholders and internally is to enable management and leadership i.e. to ensure value creation beyond what can be achieved by an unorganized group of individuals.

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Incubators As Enablers For Academic Entrepreneurship

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Abstract
The key questions that academics are struggling with are: can one teach entrepreneurship and how can it be embedded into a science, technology or engineering curriculum while maintaining high academic standards. Furthermore, prior research has pointed to a mismatch between the competencies of the highest educated and most specialised students of our academic system and the expectations of the (corporate) market (Anseel, 2012; De Grande et al., 2011). Therefore, this paper investigates the opportunities offered by 'learning-by-doing' in an ecosystem perspective.

The organization iMinds somehow acts as network integrator for research and entrepreneurship in ICT in Flanders. In this role, iMinds collaborates with universities and university colleges and other actors in the ecosystem supporting entrepreneurship.

The various mechanisms deployed to support entrepreneurship and the development of entrepreneurial skills amongst (under)graduate students are analysed. These include extra-curricular activities (workshop and coaching series). Additionally, these activities are embedded in and intertwined with the development of entrepreneurial behaviour and skills in the classical curriculum using new learning methods. Some examples can be found at Karel de Grote University College (the so-called 'The Company' minor) and at Ghent University ('student-entrepreneur' status).

The enabler to drive this evolution forward is the inclusion of incubators as part of the learning system. Students that want to start a business can spend 2 years on an MBA or join an incubator; the latter generally being accepted as a faster and more effective way of learning.

Results can be seen at three levels. Firstly, it results in an increased awareness of entrepreneurship as viable career opportunity. Secondly, these programs increase the number of student start-ups, which additionally are better equipped to grow and prosper. Since the program's start in 2011, iMinds has received eight applications for student start-ups and has supported four. Furthermore, about 25 students have made use of the (physical) incubator space. Thirdly, this ecosystem approach results in an increased cooperation between universities (e.g., at the level of doctoral schools) and with other network actors, leading to spill-over effects and more effective use of proceeds.

The universities of the future will intertwine academic education with entrepreneurship. The end goal should not be that all students become entrepreneurs, but the development of entrepreneurial skills will be beneficial to all stakeholders. This requires collaboration with these stakeholders in the ecosystem, including incubators as further enablers of entrepreneurial behaviour.

Keywords
Incubators, academic entrepreneurship, student entrepreneurs, entrepreneurship education, entrepreneurship curriculum

1 Introduction

In educational organisations as well as in academic studies on the subject, debate has been on-going whether entrepreneurship can be taught (and to what extent) and how the necessary knowledge and skills can be transferred and embedded into science, technology or engineering curricula (Henry et al., 2005a; Hannon, 2006). According to certain people, like Ries (2011, p. 4-5), entrepreneurship certainly can be taught: "*Startup success can be engineered by following the right process, which means it can be learned, which means it can be taught.*" Furthermore, academics have been concerned on how to maintain the high academic standards of these educational programs (Béchard and Grégoire, 2005; Fayolle et al., 2006; Henry et al., 2005b; Hannon, 2006; Kuratko, 2005; Smith et al., 2006). Additionally, an important remark from prior literature concerns the distinction that needs to be made between entrepreneurship and management education (Gorman et al., 1997).

Besides the concerns on how to integrate entrepreneurship education in academic curricula while maintaining the quality levels, prior research has also pointed to a mismatch between the competencies of the highest educated and most specialised students of our academic systems and the expectations of the (corporate) job market (Anseel, 2012; De Grande et al., 2011). Master and doctoral students and academic researchers do not always have the most appropriate skills for (corporate) jobs or alternatively are not always perceived as having the right qualifications (De Grande et al., 2011; Nabi et al., 2006). Entrepreneurship education could help in closing this (perceived) gap, keeping in mind that the outcome of entrepreneurship education should relate to a set of skills, knowledge and experiences useful in any business setting, rather than solely the desire to start up a new venture.

Within the aforementioned setting, this paper investigates the role of incubator programs and the opportunities offered by 'learning-by-doing' experiences in an ecosystem perspective, as part of entrepreneurship education. The paper will use the case study of iMinds as organisation and network catalyst in the Flemish region in Belgium.

The structure of the paper is as follows. In the next part, iMinds as an organisation and its general activity domains will be highlighted. Afterwards, the paper will zoom in on the specific entrepreneurship programs that have been developed for students (mainly targeting Master and doctoral students) and researchers. The fourth section deals with insights into the (preliminary) outcomes of these programs. Finally, the paper is concluded with a discussion of incubators and their role in entrepreneurship education.

2 iMinds as network integrator and its role in academic entrepreneurship

iMinds has been established in 2004 by the government of the Flemish Region (Belgium), under its original name of IBBT (Interdisciplinary Institute for Broadband Technology). The organisation, funded by the Flemish Region, was given the task to develop demand-driven for the ICT sector and foster the business and societal application and adoption of newly developed technologies, knowledge, products and services. Creating and maintaining a steady supply of new knowledge and technologies in this fast-moving industry has been recognised as crucial for a healthy ICT sector. Furthermore, supporting and organising activities to fostering innovation and entrepreneurship made up an important pillar of iMinds' activities since its inception.

iMinds as an organisation somehow acts as network integrator for research and entrepreneurship in ICT in Flanders. In this role, iMinds collaborates with universities and university colleges and other actors in the ecosystem supporting entrepreneurship. From a research side, iMinds has strategic partnerships with all five universities in Flanders (Vrije Universiteit Brussel, Ghent University, Hasselt University, KU Leuven and University of Antwerp). In this regard, iMinds is somehow a virtual organisation, in the sense that its researchers are located within these five universities and have a double affiliation (iMinds and the respective university). Through these partnerships, iMinds has direct access to and involvement with the vast majority of (ICT-related) researchers in Flanders. In this sense, iMinds acts as lynchpin in a Triple Helix ecosystem for the Flemish ICT community, integrating various actors and stakeholders as depicted in Figure 1.

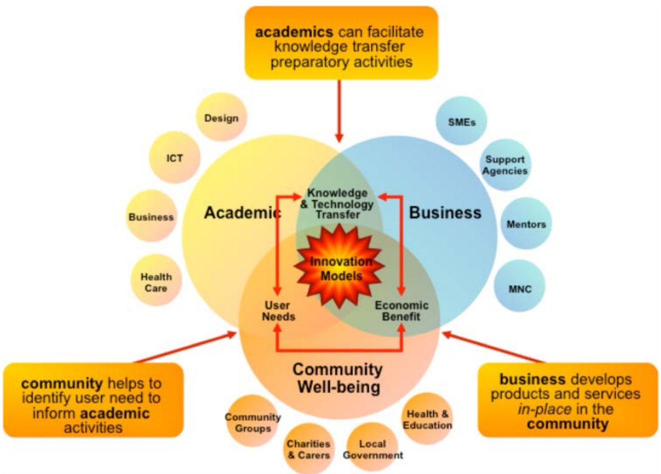

Fig. 1: Triple Helix model

The activities of iMinds are centred on two pillars: [1] collaborative and demand-driven research, in close cooperation with Flemish, Belgian and international companies, government organisations and other societal actors, and [2] foster entrepreneurial behaviour amongst researchers and externals and supporting commercialisation and other entrepreneurial activities with various programs.

Through the former, iMinds gets relatively easy access to primarily researchers (professors, post-doc researchers, project researchers and doctoral students). However, in second order the partnerships with the universities grant indirect access to the students, especially in more ***science, technology or engineering orientations (given the links with these departments through joint research activities).***

The various mechanisms deployed to support entrepreneurship and the development of entrepreneurial skills amongst (under)graduate students are analysed in section 3. These include extra-curricular activities (workshop and coaching series, incubator facilities and pre-seed funding).

Additionally, these activities are embedded in and intertwined with the development of entrepreneurial behaviour and skills in the classical curriculum using new learning methods. Some examples can be found at Karel de Grote University College (the so-called 'The Company' minor; see Trommelmans et al., 2012), in the Faculties of Sciences and Medicine and Pharmaceutical, Biomedical and Veterinary Sciences at University of Antwerp (with a specific minor on entrepreneurship and management) and at Ghent University ('student-entrepreneur' status).

3 Entrepreneurship programs for (doctoral) students and researchers

Prior studies have demonstrated that knowledge is better internalised and skills adopted to a better extent if students and researchers get the opportunity to engage in learning-by-doing experiences (Hegarty and Jones, 2008; Rasmussen and Sørheim, 2006; Smith et al., 2006). This is probably even more true for entrepreneurial skills, on which debate has been on-going whether and to which extent they can be learnt through (classic) education (Henry et al., 2005a; Hannon, 2006). Prior studies have demonstrated that heterogeneity in experiences and teaching methods is critical in entrepreneurship education (Jones and Matlay, 2011; Pittaway and Cope, 2006). Furthermore, creativity should be an important part of these learning experiences (Hamidi et al., 2008). In this sense, incubators can play a major role in fostering the development of entrepreneurial skills and providing learning opportunities in a business context. Students and researchers that have the aspiration to start up a business, can either spend one or two years on an MBA or join an incubator, the latter generally being accepted as a faster and more effective way of learning (Matlay, 2006; Rasmussen and Sørheim, 2006).

Within this line of reasoning, and as part of its entrepreneurship activities, iMinds has developed a number of tools to foster the development of entrepreneurial skills amongst researchers and students and to support those willing to start up their own venture. These tools try to address all stages of the entrepreneurial process, from early skills development and opportunity recognition onwards to hands-on coaching, pre-seed funding and facilities for the effective start up of the new business.

The current toolbox that focuses on entrepreneurial skill development consists of following elements:

› *Opportunity recognition workshops* to develop basic entrepreneurial skills for researchers and help in recognising societal and business applications of their own academic or applied research

› *Student entrepreneurship workshops* to coach students on a concrete idea, support the development of their entrepreneurial skills and highlight entrepreneurship as a viable career option

› *Intensive bootcamps* as focused coaching program to translate identified business opportunities into a first business plan, further develop entrepreneurial business sense and pay attention to team development

› *(Pre-)seed funding, expert coaching and incubator facilities* (co-working and office space), which provide opportunities to interact with and learn from other start-ups and SMEs in the iMinds' ecosystem

The tools are complemented with follow-up programs to support the start-ups that emerge from the former tools and help them and other SMEs to accelerate and internationalise.

3.1 Opportunity recognition workshops

iMinds organises a series of opportunity recognition workshops, in close collaboration with the doctoral schools of several (Flemish) universities (more info can be found at http://orw.iminds.be). The goal of these workshops is to help researcher tackling the first important challenge in applying their knowledge, technologies and research outcomes into societal and business applications: identifying opportunities where their research can help in solving (latent or explicit) problems or customer needs. Generally speaking, researchers are great at developing new knowledge and technologies, but somewhat less proficient at identifying challenges for potential customers and matching these with the solutions they could provide. The opportunity recognition workshops aim at supporting researchers, whether doctoral students, post-doctoral researchers or project researchers in regional, national or European-funded projects, in the development of their human capital (mainly entrepreneurial skills, but also e.g. pitching and presentation skills).

Most often, researchers are used to a technology-push approach, where in valorisation efforts they try to identify applications where they technologies could be deployed (starting from their knowledge or technologies). The opportunity recognition workshops try to increase the researchers' consciousness and skills for the opposite approach: what problems do (potential) customers encounter and how could the researchers' knowledge and technologies be used to bring solutions (and value) to these customers (market-pull approach). This opposite approach requires a new set of skills, attitudes and thinking (outside orientation). For the development and training of these skills and attitudes, hands-on practice within an incubator may be more effective than university classes. Through cooperation, both organisations can benefit: the universities' employees and students develop a new set of skills and expertise, developed in more market-oriented ecosystems such as incubators, whereas incubators and their ecosystems get a knowledge-boost through the latest technologies developed at universities.

3.2 Student entrepreneurship workshops

Bringing entrepreneurship education to students requires a different approach, when comparing it to programs for researchers. Students are less skilled in conducting (academic) research, but are (usually) somewhat more business-savvy and more prone to take (entrepreneurial) risks (Edwards and Muir, 2012; Lipinski et al., 2013). Therefore, a specific student entrepreneurship program has been developed, to achieve two main goals: [1] develop entrepreneurial skills amongst students, and [2] promote entrepreneurship as a viable career option, as opposed to working for an employer.

In collaboration with various universities across Flanders, a number of workshops have been put in place to help students develop their (first) business ideas and through interactive lectures and one-on-one coaching encourage them to draft their first version of a business plan. Experienced entrepreneurs coach a limited number of students or student teams on their own, concrete ideas. Topics typically include opportunity recognition, business modelling, business planning, entrepreneurial marketing and sales and the basics of financial planning, intellectual property rights and legal topics. The goal is not (necessarily) to develop full-fledged business plans, but rather to increase their appetite for entrepreneurship, further increase their enthusiasm of translating their creative ideas into business opportunities and engaging in peer learning and an entrepreneurial ecosystem.

In this regard, the cooperation between universities as educational organisations on one hand and incubators as more business-oriented organisations and ecosystems provides a win-win situation. Students get an easily accessible learning opportunity for 'action-learning' and can further increase and broaden their skills, while both universities and incubators reinforce each other in an efficient (and effective) way.

3.3 Bootcamps

Even in case researchers or students have been able to recognise and identify (a number of) opportunities, they usually need additional skills to become successful entrepreneurs (or intrapreneurs). In the process towards a first business plan and the real preparation for a (new) business, team dynamics and business planning skills come to the foreground. To a certain extent, the centre of gravity moves from human capital development towards a combination of human and social capital development. iMinds uses bootcamps to support researchers, students and (future) entrepreneurs in developing more in-depth skills and expertise in these domains.

During the bootcamp, attention is devoted to three core activities. In first instance, team formation is in the centre of attention. Especially technology start-ups (such as ICT-related start-ups which iMinds supports) are often started by entrepreneurs with a rather technological background (Mosey and Wright, 2007). Furthermore, in case a start-up is prepared for or established by a team, these tend to be rather small homogenous teams (Mosey and Wright, 2007). However, given the variety of tasks at hand, heterogeneous teams have been demonstrated to increase success rates (Aspelund, Berg-Utby et al. 2005; De Cleyn, 2011; Knockaert, Ucbasaran et al. 2010). Therefore, the first part of the bootcamp (in fact the preparation for the actual bootcamp) is devoted to building complementary and heterogeneous teams.

Practice has learned that even though a heterogeneous team outperforms a homogenous one, team dynamics trump individual skills. Building an efficient and well functioning team is a delicate balance between the necessary skills as a team and the inter-personal connection between the individuals. As the bootcamp is one of the first steps in starting a company, a well functioning rather homogeneous founding team can still be complemented with additional skills in a later stage of development.

The second pillar receiving attention in the pre-bootcamp period and during the bootcamp concerns pitching and presentation skills. In order to be attractive to potential team members, customers, partners and investors, entrepreneurs need to be able to tell a compelling and consistent story about their idea or venture.

The third set of key activities concerns the transfer of more content-related entrepreneurial skills (opportunity recognition, business modelling, business planning, entrepreneurial marketing and sales and financial planning, intellectual property rights and legal topics) during an intensive bootcamp (typically a full-time week off-site in an entrepreneurial hot-spot). In this intensive period, bootcamp participants are coached on these aspects and encouraged to further develop their ideas using the input from experienced business coaches and to take advantage of the local ecosystem in which they are immersed. In this regard, collaboration with incubators provides substantial added value, given the business coaching and access to local ecosystems through the incubator. This change of environment, outside the classical academic environment, is a critical success factor for the effectiveness of the entrepreneurship ‘education’ through bootcamps.

3.4 (Pre-)seed funding and incubator facilities

The ‘final piece’ in entrepreneurship education would be the preparation and establishment of a real start-up. Real-life action learning probably provides the best learning opportunity to obtain and further strengthen entrepreneurial skills (Hegarty and Jones, 2008; Rasmussen and Sørheim, 2006). In this sense, engaging in an incubator program could be seen as the most effective way of doing an entrepreneurial MBA. Since (most) universities cannot offer these facilities to researchers and students, collaboration with stakeholders in the ecosystem is crucial. The end goal should not be that all researchers and students become (self-employed) entrepreneurs, but rather fostering the development of entrepreneurial skills, which is beneficial to all stakeholders involved: the researchers and students themselves in the first place, but also universities, future employers, society ….

In this sense, iMinds has two key programs to support the incubation of new start-ups and entrepreneurial initiatives: [1] a pre-seed incubation program where entrepreneurs get the opportunity to develop their business, using financial support and coaching by iMinds, and [2] an physical incubator, where a mix of co-working spaces, offices, administrative support and a vibrant ecosystem encourages peer interaction and learning. The latter (co-working spaces and incubator facilities) is a mix of start-ups supported by and emerging out of iMinds' activities on one hand and external entrepreneurs joining these hotspots for their ecosystem character. This type of mix between 'internal' and 'external' entrepreneurs is hard to achieve in a one-sided university setting. Therefore, cooperation between universities and university colleges on one side, where education and research activities take place, and incubators on the other, bringing an entire ecosystem together, increase the likelihood of great learning opportunities for researchers and students through peer contacts and interactions with businesses.

Additionally, since ICT companies are "born global", each start-up that is supported by iMinds is stimulated to participate to the iMinds go-global program. This program offers companies easy entrance into International locations such as New York, San Francisco and Singapore. With the support of local staff and partners, companies have access to market knowledge and will find the support they need to get introduced to those local eco-systems. While the programs primary goal is to help Internationalise local companies, it offers an accelerated learning experience when operating in an International business context.

4 Results

Results of the various programs, even though some are very young, can (already) be seen at three levels.

Firstly, they result in an increased awareness of entrepreneurship as viable career opportunity. Increasingly, students and researchers are dreaming of a career as entrepreneur, following well-known role models on both a global level and increasingly on a more local level, where Belgian entrepreneurs start achieving success on an international level. Through the regular interactions with the universities, researchers and students become more and more aware of the fact that entrepreneurial skills can also be valuable outside a start-up context and increase the overall human and social capital. This has also resulted in an increased participation of researchers and students in programs and tools to foster the development of entrepreneurial skills.

Secondly, these programs increase the number of student start-ups, which additionally are better equipped to grow and prosper. Since the program's start in 2011, iMinds has received eight applications for student start-ups and has supported four, despite the program's rather low profile start (with a test case only in the city of Ghent). The first (small) successes are already being achieved, only 1.5 year after the launch of the program. The first start-ups have become profitable ventures and one start-up is close to securing in investment round of several hundred euros. Furthermore, about 35 students and researchers have made use of the (physical) incubator and co-working spaces, which embeds them to a larger extent in the entrepreneurial and business ecosystem in the region. The latter has the significant advantage of opening up new networks (social capital) and creating additional occasions to get feedback, learn and potentially increase (joint) business opportunities.

Thirdly, this ecosystem approach results in an increased cooperation between universities (e.g., at the level of doctoral schools) and with other network actors, leading to spillover effects and more effective use of proceeds. Universities get the opportunity to focus (more) on their core activities (conducting research and providing education), while at the same time having more learning opportunities in real business settings within reach. Additionally, their researchers and students can further increase (and diversify) their human and social capital, often enhancing their abilities in the job market. For the incubators, the connection with researchers and students enriches their ecosystem, creates more (knowledge-intensive) leads and strengthens the knowledge base on a network level. Increasingly, (independent) entrepreneurs find ways to team up with researchers and students, creating opportunities to strengthen their offerings towards customers and reinforcing their teams.

5 Conclusions and recommendations

The universities of the future will intertwine academic education with entrepreneurship. Currently, the number of universities and university colleges integrating entrepreneurship courses in their programs (in classic forms or using new learning methods) is increasingly. The end goal of these programs should not be that all students become entrepreneurs, but the development of entrepreneurial skills will be beneficial to all stakeholders (researchers and students, universities, future employers …). This requires collaboration with these stakeholders in the ecosystem, including incubators as further enablers of entrepreneurial behaviour. Including incubators as part of the educational programs on entrepreneurship holds several advantages: more effective use of proceeds, spillover effects from and towards all stakeholders involved, increased interaction between academia and business, and above all increased skills and expertise for researchers and students actively participating in these programs. As a result, incubators could be seen as catalysts and enablers for effective entrepreneurship education programs in academic organisations.

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The Role Of Technology Broker For The Development Of A Local Competitiveness

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Abstract

Purpose of this paper is to illustrate the role of technology broker in local contexts in which the aim is to initiate a process of economic development that focuses on technology transfer to SMEs, exploiting public or private research results.

The present work aims to report a practical case of territorial development based on technology transfer: Basilicata Innovazione, an initiative that triggers for the first time a model for the competitive development of Basilicata region, in Italy, based on innovation.

The structure of the work includes: an economic and territorial description of the Basilicata region's context, an analysis of the technology broker role, which sets out the characteristics and skills that this figure requires and illustrates the working method of the broker, highlighting the most frequent/important critical points and listing the adopted tools. Finally, it also describes the relationships between the broker and the other actors of the "innovation process".

The result is to show the importance of the technology broker as a central figure in the economic development of SMEs in Basilicata region, based on technology transfer.

Keywords

Technology broker, technology transfer, local competitiveness, exploitation of research results

1 Introduction

Purpose of this work is to illustrate the role of technology broker in local contexts whose aim is to initiate a process of economic development focused on technology transfer to SMEs, exploiting public or private research results.

In such contexts technology broker plays an important role, as it manages the identification and verification process of needs for the businesses operating in the area. He defines the innovation profile of the company, identifies the right skills and selects solutions providing concrete answers to the emerging innovation needs. Then he plans development paths and follows the project realization, coordinating working groups, accompanying the company in its relations with the experts, monitoring every step to achieve the expected goals.

The present work aims to report a practical case of territorial development based on technology transfer: the "Basilicata Innovazione" project. This initiative was promoted in the second half of the 2009 by the public administration of Basilicata region (in Italy) and the Science and Technology Park “AREA Science Park” – Trieste. It triggers for the first time a model for the competitive development of this region based on innovation.

The structure of the work includes: an economic and territorial description of Basilicata context, also in terms of "focus on innovation"; an analysis of the technology broker role, which sets out the characteristics and skills that this figure requires. It further illustrates the working method of the broker, highlighting the most frequent/important critical points and listing the adopted tools. It also describes the relationships between the broker and the other actors of the “innovation process”.

The result is to show the importance of the technology broker as a central figure in the economic development of SMEs in Basilicata region, based on technology transfer.

2 The local contest

Basilicata is a small region of southern Italy, which covers about 10.000 sq km and in 2010 had a population slightly under 600.000, over 131 municipalities, of which 97 have a population under 5.000 inhabitants, and of these, about the 60% has a population under 2.000 inhabitants. This small area is characterized by an entrepreneurial system that for the most part of micro enterprises, mostly family-run, which operates mostly in traditional sectors. There is also a scientific supply system consisting of single universities and research centers working in well-defined areas.

2.1 The regional entrepreneurial

Table 1 shows an overview of regional business system, based on 2010 data of the National Statistics Institute (ISTAT).

Sector	Companies
Industry	3.271
Building	4.891
Commerce	14.924
Services	12.412
Total	35.498

Table 1 – Regional businesses system

The regional productive structure is characterized by the predominance of micro and small companies. The estimated size of regional companies is summarized in Table 2, showing a distinction between industries and firms in the service sector.

Number of employees	Industry (%)	Services (%)	Overall (%)
< 10	91,4	97,5	96,1
≥ 10 and <50	7,9	2,3	3,6
≥ 50	0,7	0,2	0,3
Total	100	100	100

Table 2 – Size of businesses

In Basilicata almost all (99.7%) production system is represented by enterprises which employ fewer than 50 employees. 90% of these is made by micro enterprises, with a number of employees of less than 10. Local economy is characterized by a diversification of production divided, into the following industrial sectors:

› *Automotive*, with the manufacturing plants of Fiat Group located in the northern area of the region.

› *Earth Observation and ICT*, with a young district leading studies in the field of detection technologies, systems monitoring, reporting, prevention and remedying of environmental risks related to the hydrogeological or climate conditions of the region.

› *Agro-industry*, a sector which extends throughout the region, but with a particular concentration of firms in the south area of the region, where there is the major horticultural regional pole, and in the northern area, specialized in the production of wine, oil, mineral water and important international food industries, such as Barilla Group.

› *Upholstered furniture*, a sector constituted from about 70 companies. About 80% of revenue comes from exports (mainly the U.S.) and it is estimated that the production represents 10% of world production.

› *Plastics and Chemicals*, with companies concentrated in the production of polymers and synthetic fibers, mainly for automotive

› *Textile:* in the northern area of the region there are some companies specialized in production of bra and underwear.

› *Construction sector:* building is a strategic sector for the region, since its value is above the national average (8.9% against 6.1% in Italy).

› *Energy:* more than 75% of the total oil extracted in Italy comes from Basilicata, and significant amount of total national gas is produced here. The most important player in this sector appears to be the ENI, and other international oil companies (Total, Shell) are also relevant.

2.2 The scientific supply

Basilicata is characterized by a significant presence of subjects producing technical-scientific knowledge in strategic sectors for the social and economic development of the territory. The public presence within the scientific system is due to the activity of several important research centers such as:

- *The University of Basilicata,* one of the central research system, with several scientific faculties and departments.
- *The National Research Council (CNR)*: the mainly research activities are directed to the development and integration of technologies about "Earth Observations" aimed at the study of geophysical processes and environmental issues, with particular attention given to natural hazards, security and cultural heritage.
- *The Italian National Agency for New Technologies, Energy and the Environment (ENEA),* operates in the areas of energy, environment and new technologies to support the policies of competitiveness and sustainable development of the country. Its main tasks are related to the promotion and conduct of research and technological innovation, including the creation of prototypes, also thanks to the collaboration with organizations and institutions abroad.
- *The Center for Space Geodesy* develops systems for the management of natural disasters and, in particular, forest fires, landslides and mudslides. It is also engaged in remote sensing, space robotics and interplanetary missions.
- *The Institute of Plant Genetics (IGV),* which carries out research in the agricultural sector aimed at meeting the demand for innovative technologies from the pharmaceutical, chemical and food industries.
- *The Council for Research and Experimentation in Agriculture (CRA*) operates in several areas of research: it studies the nutritional requirements and the relationships between the power supply and the quality of products, the genetic improvement of plant species and the development of diagnostic techniques for the improvement of food safety, product quality, traceability in production processes, the technical management of cropping systems with particular regard to the use of agri-environmental resources, environmentally friendly planning systems and production techniques, the patterns of integrated cultivation and organic farming.

The lack of science and technology parks in Basilicata is compensated by technology centers working on Earth observation and ICT.

2.3 The regional innovation gap

Basilicata region is characterized by a high number of micro businesses, often family-run, with no staff for research and development, and operating in traditional sectors. An effect is a low propensity to innovation, as confirmed by the data of the European Patent Office, according to which Basilicata, in 2009, proves to be the penultimate Italian region in terms of patent applications. Actually we can observe to 2 applications against 76 in Campania or 38 in Puglia (border regions).

In addition to that, Basilicata spin-off are the youngest ones, with an average age of 1.8 years compared to 3.7 average of Southern Italy and to 5.0 national average. This proves how Basilicata underestimates the importance of exploiting research results.

The National Statistics Institute (ISTAT) shows a lower percentage value of R&D resident population if compared national average and Southern regions' situation. This value takes into account the personnel engaged in R&D in universities, industry, government and private non-profit institutions.

Regions	**Number for thousand inhabitants**
Basilicata	**1,7**
Italy	3,8
Northern Italy	4,8
Central Italy	4,6
Southern Italy	2,0

Table 3 - R&D Employees (2009)

If we analyze the R&D spending of local enterprises, calculated in relation to GDP, the result is a total cost of 0.1%, a much lower value to national average and other southern regions of Italy.

Regions	**Percentage of GDP**
Basilicata	**0,1**
Italy	0,7
Northern Italy	0,9
Central Italy	0,5
Southern Italy	0,3

Table 4 - Expenditure of firms on R&D (2010)

The following table shows the number of firms which introduced process or product innovations in 2010. The collected data refer to businesses with more than 10 employees, active in industry, construction and service sectors. In Basilicata region, only 15%

of companies have innovated, a value lower to the half of national average (over 30%) and to other southern regions (about 23%).

Regions	Percentage of total
Basilicata	**15,0**
Italy	31,5
Northern regions	36,2
Central Italy	25,7
Southern Italy	23,2

Table 5 – Firms that have introduced process or product innovations (2010)

The Regional Innovation Scoreboard 2009, prepared under the PRO INNO Europe® of the Directorate General for Enterprise and Industry, shows a classification of the regions belonging to the 27 EU Member States (plus Norway), on the basis of their level of innovation. Within this classification, the Basilicata is one of those areas where the level of innovativeness is medium-low.

From the analysis an important fact emerges: in Basilicata there is an environment rich of small enterprises, often young people, operating in traditional industries. Thanks to innovations these firms may well improve in terms of competitiveness. Hence the importance and the role of Basilicata Innovazione as a structure able to link the innovation needs of SMEs with the skills of universities and research centers located throughout the area.

3 Basilicata Innovazione

The strategic objective of the initiative called Basilicata Innovazione is to create a permanent system "research-firm", which triggers a virtuous circle answering the innovation need of local companies, involving the best expertise in the research and providing adequate support throughout the process of innovation adoption. The goal is to increase the quantity and quality of skills transferred to companies, promoting the creation and the development of companies with a high level of knowledge. We can summarize in this way the key points of the project:

› to increase a greater awareness of local companies about the issues of research and innovation;

› to strengthen the local business through innovation;

› to achieve coordination between firms, universities and research centers, and to establish a connection between the firms and the research, both on a national and an international level;

- to make available to all local firms the know-how offered from the regional and extra-regional research structures;
- to exploit both the results of research and technological equipment (specialized laboratories, equipment specifications, etc..) of the region;
- to enhance the use of highly educated human resources involving them on industrial processes;
- contribute to the create a regional policy for the development of enterprises based on technological innovation.

Basilicata Innovazione provides services to support companies and researchers along paths of innovation. These services can be classified into the following four areas:

(1) Information supporting decision-making;

(2) Exploitation of research results;

(3) Enterprise competitiveness;

(4) Enterprise creation.

3.1 Information supporting decision-making

The first area of intervention is responsible for providing companies or researchers with information related to the protection of an idea, to opportunities arising from new technologies, to find out how competitors are moving, to verify the reliability of potential partners. Patent prior art searches are made; they allow to check the requirements for patentability of an invention, to avoid investing in research already covered by some patent, to monitor the technology status of a target market. Another type of support offered to companies concerns the monitoring of technologies, carried out through the use of business intelligence tools, which aims to support corporate decision-making for planning new products and processes, for detecting emerging technologies and guiding company investments and expansion opportunities. Finally the evaluation of the economic and financial partners (or clients, suppliers, distributors) can be provided to people working in Basilicata region through an innovative rating system, checking the reliability of potential partners prior to any formal agreements. Final target is an efficient management of the company.

3.2 The exploitation of research results

Basilicata Innovazione provides researchers with a set of tools, services and methodologies bringing on the market those research results showing potential industrial application. This enhancement process consists of a first part of boot to the market, which is indispensable to verify the presence of all the requirements, and which is performed through a series of activities:

- scouting: the interactions with researchers aimed at gathering information on the results and to identify the first case of application;
- a phase of documental and patent analysis, aimed at verifying the effective priority of the result, define the technology landscape in which to place and provide useful inputs for the assessment of patentability and scenario analysis;
- characterization of the market scenario for the marketing of the result;
- design of the enhancement, through the identification of the stages of result development to make it conform to the requirements for marketing and protection. Preparation of a work program, including an assessment of time, cost and resources needed to do this.
- In the second stage researchers are supported in assessing what could be the best route for the exploitation of their research results, which basically provides the following alternatives:
- the transfer of research results, supported through the identification of potential users, the management of contact and transmission of technical documentation, the support with the preparation of contracts, the negotiation of agreements and the signing of contracts;
- the identification of potential partners for collaborative projects and support with the preparation and the negotiation of contracts;
- the creation of a spin-off, supported in all its stages of development.

3.3 Enterprise creation

Basilicata Innovazione has created a "first mile incubator", whose objective is to welcome future entrepreneurs and support them in developing their own business plan, through a process that consists of the following steps:

- evaluation of the business idea, through the establishment of a scientific and technical committee to which the applicant must submit a description of your business idea and a business plan in preparation for the birth of the new company;
- pre-incubation: the provision of equipped places and the start of the various project activities, the possibilities for the future entrepreneur to access a set of services with high added value;
- enterprise creation, at a time when there are the conditions of economic and operational autonomy. Basilicata Innovazione participates in the enterprise creation with a minority stake and agrees with the proponent most appropriate way-out strategy.

3.4 Enterprise competitiveness and the role of technology broker

The competitiveness development of enterprises operating in Basilicata region is performed through the implementation of innovation projects, a structured path whose protagonist is the technology broker. The Italian Association of Technology Brokers (AIBT) is born with the aim to work for the recognition and institutionalization of the professional Technology Broker for the codification of the procedures adopted in the technology transfer activities, and the creation of networking between professionals in this particular field.

We could "borrow" a first definition of Technology Broker from the AIBT, which defines it as:

> *"Something more than the person who helps organizations improve their performance by using existing technologies not developed in-house and not on the market. He knows not only the scientific community but also the needs of the market and, with systematic investigations, makes contact and the synergies between companies and researchers."*

The technology broker is more than just a facilitator of innovation or the attorney of innovative technological opportunities of industrial interest. The broker must be a partner of companies operating in a territory with a thorough knowledge of the local business, the local needs and innovations and technologies that the world of public and private research is able to offer. He must know the operational mechanisms and market rules affecting both these worlds, he must be able to anticipate trends in the technological development of the sectors he competes with or that most interest him. He must be able to facilitate the process of networking between businesses, from a local dimension until reaching partnership at international level.

With regard to the professional background of Technology Broker, the academic training of origin, although in some cases it is essential to better understand the operational processes that are the basis of any need for innovation, however, is secondary to the ability to have a global vision of issues. This is because this profession in some ways represents a convergence of trajectories that can come from research, industry and administration. In this sense, technology broker should have, or acquire, a basic training in all three areas. The requirements, however, go beyond vocational training and include also and above all the ability to interface with different worlds (companies, universities and research centers, end users) that have very different dynamics and do not know each other's needs, because they often do not cooperate. The broker’s ability should therefore be to interpret these needs, and try bring them to a common solution.

4 The role and activities of Basilicata Innovazione technology broker

4.1 The management of innovation projects

The first response actions necessary to structure a path of innovation consists in defining the innovation needs for business. This occurs through a capillary activity of "door to door" visits carried out among regional companies of any productive sector. During the visits, the broker draws up the company profile in order to collect information about company history, products, processes, position on the market and available technologies, the ability to innovate or protect any internal innovation.

Once broker have defined the innovation need and the company profile, the next step is to identify the best skills among research structures or private consultancy, able to provide an adequate response to the companies’ needs. The task of the technology broker at this stage is to provide the expert with a very detailed framework of the company, the issue or opportunities for improvement that the company wants to take, in order to find solutions that can offer concrete answers to innovation needs emerged. Following a planning phase of development paths, the technology broker is responsible for monitoring every step of the project, for coordinating the working groups, and for supporting the company in its relations with the experts.

In some cases, the innovation needs expressed by the companies, can also be solved directly by the technology brokers operating in Basilicata Innovazione, thanks to their technical skills within any field of local productive sectors. Their highly specific tools allow them to monitor the state of the art and development trends of critical technologies for the company.

Basilicata Innovazione has actually established a system of Competence Centers (called Innovation Network) dedicated to the promotion of innovation culture. The Competence Centers provide services and assistance to local SMEs on issues of most significant strategic interest. The following ones have been identified: Sustainable Mobility (automotive sector), Agro-Industry, Energy and Environment, Earth observation and ICT, Plastic and new materials, Wood and upholstered furniture, Building.

4.2 The facilitation of the networking process

Another aspect of primary importance in the activities of the technology broker, concerns the ability to facilitate the networking process. The broker may play a role as a facilitator in the development of business networks, designed as a partnership between companies operating in the region, including several areas, which are combined with their knowledge, experience and technology for development of innovative products or services to offer in the market. This is possible thanks to the global vision of the productive land, acquired from the broker through the ongoing contacts with companies.

The networking process can become a reality through assistance to companies for research and offering of technologies, skills and partnerships. The promotion of international relations in the fields of research and innovation represents a unique opportunity for economic growth of the region. A tool available to Basilicata Innovazione technology brokers is the Enterprise Europe Network, whose mission is to help SMEs to develop their innovation potential and raising awareness about EU policies.

4.3 The evaluation of company performance

Technology broker is also involved in benchmarking activities, a process of measuring the performance of companies operating in the region, through the comparison with competitors. The analysis of business efficiency and the comparison with the competitors at the international level, are carried out by a dedicated team of technology brokers, mainly composed of people with a background in economic matters, through the use of specialized computer tools. These brokers implement an objective analysis, based on the values of financial statements, about the management of productive resources of the company. After that they compare that particular reality with the competitors and offer ideas in terms of costs reduction and business efficiency.

4.4 The protection of ideas and the organization of training sessions

The Basilicata Innovazione broker cooperate with the area that deals with support for intellectual property, seeking to provide assistance both in terms of in-depth information about the idea that entrepreneurs or researchers want to protect, and where possible through their knowledge of the technologies of that specific sector. The broker also enables firms or researchers to identify external experts in the field of patents that can help in the following activities: training on intellectual property rights, patent drafting, preparation of licensing contracts, assistance in negotiation processes. Finally the broker is responsible for the planning and management of meetings and workshops dedicated to entrepreneurs and human resources of micro, small and medium-sized enterprises to promote the innovation culture and best practices, and to develop managerial mode for more effective productive resources.

4.5 The most frequent difficulties in the relationship with companies

It’s important for a technology broker to have a deep understanding of the businesses operating on its territory, of the available technologies, markets and issues or requirements that companies are forced to face in carrying out production activities. The very first critical face of broker’s activity is the management of the "first contact" with the company. The difficulties faced by the broker include:

› the difficulty to explain in a short time the characteristics of quite a new profession and the mission of its organization;

- the need to go straight to the meeting with the company, trying to highlight the opportunities through case studies;
- the frequent impossibility to talk directly to the entrepreneur, and to overcome the administrative filters, which cause loss of interest;
- the need to guess the interest of the firm about research and innovation.

After this first hurdle, and ones got a meeting in a company, broker must prepare the best management of "visit". To do this, he has to collect all possible information about the company (products and processes) and the sector to which this refers, in order to appear before the entrepreneur prepared and to create a sort of feeling that necessarily need to bring out needs or hidden dreams. Then the conduct of the visit starts from an analysis of the current state of the company through the application of a variety of information about the history, the size of the company in terms of employees and turnover, the type of target market, process or products and the technologies used. At this stage, the difficulties associated with the interview between the broker and the entrepreneur are substantially related to the sincerity with which he answers to the questions, questions designed to highlight needs in technology, useful to create new products or improve characteristics of existing ones or to resolve process problems.

Basically when conducting the interview the broker is required to have:

- a good ability to synthesize, understand and focusing the needs and the performance that the company wants to achieve;
- the ability to focus on the real needs, distinguishing them from mere curiosity of the entrepreneur;
- the utmost discretion and confidentiality in handling sensitive information or industrial know-how.

This qualities must be associated with the availability of the company to undertake the work of innovation, networking and sharing of know-how and any research results.

5 Achievements in technology transfer activities in Basilicata region

5.1 The overall results of Basilicata Innovazione

During the first three years of activity Basilicata Innovazione has achieved excellent results both from the point of view of innovation actions on local businesses and of the enhancement and protection of public or private research results. Table 6 summarizes these results through performance indicators agreed with the project partners (government of the Basilicata region).

<table>
<tr><th>Performance Indicators
(30/06/2012)</th><th>By initial agreement</th><th>Results</th></tr>
<tr><td colspan="3">Technology Transfer Service</td></tr>
<tr><td>Companies contacted</td><td>200 - 250</td><td>705</td></tr>
<tr><td>Companies visited</td><td>-</td><td>646</td></tr>
<tr><td>Innovation actions carried on business</td><td>-</td><td>349</td></tr>
<tr><td>Companies involved in innovation actions</td><td>50 - 80</td><td>299</td></tr>
<tr><td colspan="3">Exploitation of research results</td></tr>
<tr><td>Researchers visited</td><td>-</td><td>117</td></tr>
<tr><td>Projects to enhance the research</td><td>15 - 20</td><td>31</td></tr>
<tr><td>Interventions exploiting the results of research carried out</td><td>-</td><td>15</td></tr>
<tr><td colspan="3">Information to support decisions</td></tr>
<tr><td>Prior art searches (patents, trademarks, design)</td><td>-</td><td>112</td></tr>
<tr><td>Patent prior art searches (for firms)</td><td>-</td><td>65</td></tr>
<tr><td>Patent prior art searches (for researchers)</td><td>-</td><td>28</td></tr>
<tr><td>Patent prior art searches (for private individuals)</td><td>-</td><td>5</td></tr>
<tr><td>Patent prior art searches (for future enterpreneurs incubated)</td><td></td><td>2</td></tr>
<tr><td colspan="3">Creation of new businesses</td></tr>
<tr><td>Subjects mets
(business ideas)</td><td>-</td><td>87</td></tr>
<tr><td>Detailed analysis</td><td>-</td><td>15</td></tr>
<tr><td>Proposals for incubation</td><td>-</td><td>11</td></tr>
<tr><td>Projects of innovative firms incubated</td><td rowspan="2">5 - 10</td><td>6</td></tr>
<tr><td>(including spin-off of research)</td><td>3</td></tr>
<tr><td>Future enterpreneurs</td><td>-</td><td>18</td></tr>
</table>

Table 6 – Performance indicators

The analysis of the data shows the results which are beyond expectations, with a number of companies contacted by brokers approximately three times over the expectations before starting the activities. 92% of the companies contacted has shown interest in the topic of innovation and proposed activities. 46% of the companies visited by brokers was involved in innovation and technology transfer projects, reaching a number of 300 enterprises involved, equal to four times the expected result.

The activities of the area involved in exploitation of research results have also shown better results than expected, with a number of projects to enhance 55% higher than the threshold.

The first mile incubator, during the first three years, has met several subjects and evaluated a variety of ideas, six of which have become incubated "development groups", in line with the target. To support all of these processes over a hundred prior art searches have been carried out.

5.2 Technology brokers achievements

The achievements described above are the result of an extensive infiltration of technology brokers in the businesses environment of Basilicata region, and of the scientific and technological scouting within the territory. The activity of the broker has in fact seen the involvement of several associations, consortiums and cooperatives in the area, with whom many projects have been launched.

Table 7 shows a classification of interventions by activity field of companies.

Activity fields	Innovation interventions
Electronic	7
Energy	8
Textiles	8
Press and print	10
Earth observation and ICT	17
Automotive	31
Building	35
Plastic/ glass / chemicals processing	37
Technical and environmental services	31
Mechanical and metalworking	28
Woodworking	60
Agro-industry	90

Table 7 – Interventions by activity fields

As is easy to see there is a predominance of interventions on agro-industries and woodworking. This is because in Basilicata region there is a strong spread of micro and small enterprises involved in processing for food use (including a center dedicated to the bottling of mineral water). We also have several companies involved in the production of doors and windows, as well as an industrial district dedicated to the production of upholstered furniture (sofas and armchairs).

Table 8 shows the main themes on which brokers have focused their interventions within the first three years of activity.

<table>
<tr><th>Topics of innovation interventions</th><th>Companies involved</th></tr>
<tr><td rowspan="2">Technical assistance to develop expertise on environmental sustainability in the building sector</td><td>200
(professionals)</td></tr>
<tr><td>18</td></tr>
<tr><td>Improvement of products and processes in the field of plastics processing</td><td>16</td></tr>
<tr><td>Analysis of industrial profiles of companies and identification of development and growth in size proposals</td><td>24</td></tr>
<tr><td>Technical assistance for the automation of production processes</td><td>10</td></tr>
</table>

Topics of innovation interventions	Companies involved
Enhancement of indigenous plant species for the realization of furniture products on an industrial scale	10
Improvement of home decor products on the basis of scientific principles of Ergonomics	15
Check the services offered and business models of companies operating in the field of Earth Observation, in order to identify new markets	7
Support businesses to search and offer technology in international markets and search technology partners	7
Analysis and identification of innovative materials for the improvement of existing products or the creation of new products	37
Other topics	5
Total	**349**

Table 8 – Topics of innovation interventions

Some of the innovation projects implemented were born thanks to the ability of brokers to aggregate technology companies on topics shared by a number of operators in the same sector, such as the field of woodworking, plastics or earth observation. Other projects are based on the identification of cross-cutting initiatives useful to answer the question of innovation for more productive sectors, such as research on new materials or projects on issues of competitive development.

Table 9 summarizes the forecast of the impact of technology transfer activities carried out by Basilicata Innovazione brokers for the enterprises in the area, based on data provided by a sample of 81 companies benefiting from innovation actions.

Impact indicators	Results
Estimated increase in sales	+ 8,1%
Estimated increase in employment	+ 7,3%
Process innovation	Expected in 53.4% of cases
Product innovation	Expected in 28.4% of cases
Management innovation	Expected in 5.7% of cases
No significant innovation	Expected in 12.5% of cases
Patents and Trademarks	6 (including 3 patents to support local production cluster)

Table 9 – Estimated impact

The sample of analyzed companies shows a chance for the region to increase sales of its companies (+8.1%) and an employment growth (+ 7.3%). In 87,5% of cases, the intervention of technology brokers brought benefits to companies in terms of process / product / management innovation. During the first three years of technology transfer activities the region has also faced an increase of requests for protection of intellectual property, in terms of patent applications supporting local productive clusters.

6 Conclusions

This work would be a contribution aimed to better define the role of technology broker, both in terms of distinctive features required and of critical issues related to the relationships with other players.

The case study presented shows how the technology transfer process cannot be separated from the figure of the broker. His deep knowledge of companies and of their innovation needs, is crucial to the development of a territory like Basilicata, characterized by a traditional system of SMEs which shall strongly benefit of a technology transfer system based on exploitation of research results.

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Crafting University-Industry Interactions: A typology and empirical illustrations from Uppsala University, Sweden

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Abstract

Relying on an embedded case study over two interaction-stimulating tools of Uppsala University (AIM-day and SMURF), this paper addresses four research questions concerning (1) the types of university-industry interactions, (2) the way this university crafts such interactions, (3) the perceptions and assessments made of these interactions by the various involved actors, as well as (4) the differences in such perceptions and assessments. As for the first question, we formulate a typology of university-industry interactions including "participation", "cooperation", "collaboration" and "relationship". As for the second question, the paper develops a process model connecting these four types of interactions and revealing the importance of a fifth type of "potential" interactions between researchers and companies, namely "contacts". As for the third and forth question, we identify both convergence and divergence in the perceptions and assessment of university-industry interactions made by the three involved parties – researchers, companies and university management: there is convergence in researchers' and companies' appreciation of contacts, cooperation and collaborations, on the one hand, and the key performance indicators applied by university management to measure such interactions, on the other hand; but a divergence appears in the relative lack of indicators measuring relationships in exhaustive ways, despite the great value that both researchers and companies attribute to them.

Keywords

University-industry interaction, typology, cooperation, collaboration, relationship, KPIs.

1 Introduction

When it comes to commercializing science Sweden makes an interesting case as Swedish universities are mandated by law to commercialize their science, while a national regulation, known as "the teacher's exemption" grants all rights of a scientific discovery to the researcher (Nilsson, Rickne & Bengtsson, 2010). This situation makes the traditional linear spin-out funnel (Clarysse et al., 2005), based on the sequence "select discoveries/patent them/license them-exit", less of an obvious choice for Swedish universities, and induces them to apply also alternative mechanisms to diffuse science to industry. Several of these mechanisms are instead based explicitly on stimulating various forms of university-industry interactions (cf. Jacobsson & Perez Vico, 2010).

However, as stressed by Perkmann and Walsh (2007), current research seems to lack *deep descriptions and analyses* of university-industry interactions, especially of universities' efforts to craft such interactions from start, that is, *before they are established relationships*. Therefore, this study adopts an exploratory approach and analyses how a specific university, Uppsala University, Sweden, operates to stimulate university-industry interactions. Our purpose is addressing four questions: (1) what types of interaction can be identified between these parties? (2) how does a university practically operates to craft these interactions? (3) how are the results of these efforts perceived and assessed, including formal measures in terms of KPIs (key performance indicators), by the involved parties, namely the university management, researchers and companies? (4) are there differences and similarities in the various parties' assessments and measurements of university-industry interactions?

Relying on theory over inter-organizational relationships (Johanson & Mattsson, 1987; Håkansson & Snehota, 1995; Håkansson & Ford, 2002), we penetrate the key features, components and processes of university-industry interactions in abstract terms. Key dimensions are for instance the depth, formality, mutuality, involved resources, intensity and duration of these relationships (Ibid). This theoretical review is the starting point for developing a typology of university-industry interactions, which we refine from the analysis of two case studies, centred on two different interaction-stimulating mechanisms implemented by Uppsala University, AIMday and SMURF. AIMday is a tool stimulating researchers and industry to meet unconditionally and discuss topics that interest both parties; whereas SMURF's purpose is that companies and researchers collaborate on a joint project with concrete goals. The two cases are expected to stimulate different types of interactions between university and industry, and display accordingly different KPIs.

The remainder of the paper is organized as follows: the next section reviews theories on university-industry interactions and builds our theoretical frame; then comes our methodology, followed by a joint empirical section featuring our two case studies. The next section analyses the cases by applying our theoretical concepts in order to define our typology of university-industry interactions, as well as to identify similarities and differences in how these interactions are perceived and measured by university management, researchers and companies. The paper concludes with policy implications and avenues for future research.

2 Theoretical framework

This section starts by reviewing the concept of university-industry *interaction*, as viewed from the literature on the commercialization of science and technology transfer. Our theoretical review moves then to the IMP perspective, which investigates the general issue of *inter-organizational* interaction. University-industry interaction can in fact be considered as a sub-category of inter-organizational interactions and relations, phenomena for which the IMP approach provides several useful analytical tools, dimensions and models. Finally, we discuss the parties involved in university-industry interactions, stressing the perceptions and assessments of these actors about the ongoing or hoped for interactions between academia and industry. We conclude this section by combining the key concepts reviewed into a theoretical frame over the role of KPIs in crafting university-industry interactions.

2.1 University-industry interactions

According to the Triple Helix model (Etzkowitz, 2004b; Etzkowitz & Leydesdorff, 2000) university-industry interactions are important to promote knowledge diffusion from the latter to the former and to the broader society. Such interactions intervene also in more detailed and variegated ways in the various mechanisms followed by universities in order to diffuse or commercialize their science (for a review of these mechanisms see e.g., Nilsson et al., 2010; Jacobsson & Perez Vico, 2010; Clarysse et al., 2005; Mowery, 2005; Etzkowitz, 2004a: 72-3).

Negotiations, such as those required for licensing out a discovery or taking stake in a spin-off, entail rather close interactions between universities and companies. An even deeper and closer relation, lasting longer than just a set of negotiations, is instead necessary when industry and academia conduct joint research, share personnel or equipment or are bound by long-term consulting, education and contract research agreements. In these situations, interaction is substantiated by the two parties – university researchers and the company – getting directly involved in each other's activities and resources (see Plewa Quester & Baaken, 2005). In some cases, interaction transforms into full blown industry-university *collaborations* (Santoro, 2000), and in even fewer cases into research *alliance* (Bercovitz & Feldman, 2007).

Even if he does not provide a clear definition of the "collaboration" type of interaction, Santoro (2000: 258-60) starts from the broad notion of "working together" and includes in the concept of "collaboration" such elements as (1) financial support of academic research by industry, (2) "cooperative" research conducted by university staff, either contracted by the company or together with company staff, (3) "knowledge transfer" in terms of dedicated education programs for companies, shared personnel or recruitment of university-trained students and PhDs, and (4) "technology transfer" including such activities as solving company-specific problems and licensing out particular inventions. Similarly, Bercovitz and Feldman (2007) do not define explicitly what type of interaction a research "alliance" is, but they (Ibid: 933-4) suggest that an alliance-like interaction can entail both a *single transaction* (e.g., only one research project or the purchase of just a specific patent) and *in-depth long-term relationships* including multiple transactions performed over several years (e.g., multiple sponsored projects, regular hiring of graduate students, personal ties with faculty members).

Therefore, even without a clear definition of the “collaboration” and “alliance” types of university-industry interactions, we can consider them as more advanced and sophisticated types of interactions between industry and academia compared to simply “meeting”, “creating contacts” or “communicating” with each other. However, focusing research only on the more advanced type of interactions restricts the attention to a very narrow number and type of interactions (those that survived or appear as strongest), while neglecting a very large number and several other forms of interactions (those that are a precondition for the former). Therefore, this paper explicitly considers also the “weaker” or shorter-term types of interactions between universities and companies, namely those interactions including only communication activities or simply acquaintances.

University-industry interactions, irrespective of their strength and duration, include several types of links (Vedovello, 1997, 1998): formal (e.g., contracts) and informal ones (e.g., personal contacts), or human resource links (e.g., shared personnel). How many and how deep these links will be between a specific university and a company depends on the *characteristics* and *strategies* of these two parties. For instance, companies conducting intensively own R&D, especially if of explorative character, tend to have deeper and multifaceted interactions, with multiple links to their university partners (Vedovello, 1998: 224 Bercovitz & Feldman, 2007).

As for the characteristics of universities, there are at least two relevant organizational levels that impact on interactions with industry: the *academic researchers* and the *university administration* (including especially Technology Transfer and Industrial Liaisons Offices). As for the first level, individual researchers’ status and previous experience strongly impacts the type of interactions with industry they promote, with a clear preference for direct interactions (e.g., consulting or joint research) instead of patenting and spin-out activities (D’Este & Patel, 2007). Researchers with increasing experience of interacting with industry, higher academic status and of younger age are typically involved in more variegated types of interactions with industry (Ibid: 1309). Prestige and research quality of research groups and departments do not imply necessarily increased variety or depth of interactions with industry, since less prestigious groups are more prone to accommodate any request from industry (Ibid).

As for the university management, Technology Transfer and Industrial Liaisons Offices facilitate university-industry interactions, but only if they balance the *centralization* of competences (e.g., in technology scouting and IPRs) and of common incentive schemes with the *decentralization* necessary to provide dedicated service to single research groups and companies (Debackere & Veugelers, 2005). Moreover, a university’s strategy giving priority to the “spin-out funnel” (Clarysse et al., 2005) as opposed to more interactive and informal mechanisms (Jacobsson & Perez Vico, 2010, Nilsson et al., 2010) has a great impact on the type, depth and duration of interactions with industry.

2.2 An IMP perspective on university-industry interactions

The IMP (Industrial Marketing and Purchasing) Group (www.impgroup.org) is a research community and theoretical perspective which has been analyzing, both empirically and conceptually, inter-organizational interactions, relationships and networks for the last 30 years (see Ford, 1980; Gadde & Mattsson, 1987; Axelsson & Easton, 1992; Håkansson & Snehota, 1995; Araujo, Dubois & Gadde, 1999; Ford & Håkansson, 2006; Mattsson & Johanson, 2006, Håkansson et al., 2009). The very empirical background of IMP is an in-depth analysis of the interactions going on between industrial customers and suppliers, conducted by means of the early "Interaction Model" (Håkansson, 1982: 15-22) featuring the following key constructs:

1) the *parties* involved in interaction, both the organization (including their strategy, technology and structure) and the individuals (represented by their aims and experience); 2) the very *interaction process*, divided into *short-terms exchange episodes* of products/services, information, financials and social nature, and *long-term relationships* encompassing institutionalization of exchanges and especially *adaptations*; 3) the *atmosphere* enveloping the interacting parties and process, in terms of mutual power/dependence, cooperation, cultural closeness and expectations.

According to this model (and the IMP view in general) a "business relationship" is a special type of inter-organizational interaction, which emerges when, next to simple exchanges of resources and information (the classical "transactions"), also *adaptations* appear (Ibid: 19). Admittedly, even repeated transactions without any adaptation from either party would not qualify an inter-firm interaction as a relationship. Adaptations are concrete changes in the activities, routines, resources or organizations of the two parties involved. Adaptations can be viewed as investments made by one or both parties with the expectation of obtaining some benefit in the future: for instance, more efficient internal processes geared towards a certain counterpart or solutions better fitting the need of a counterpart. Hence, an important dimension of the inter-organizational interactions that turn into full-blown relationships is the *commitment* to make such investments and adaptations specifically for a counterpart and the *trust* that the counterpart will behave favourably (keeping promises, increasing future volumes, respecting confidentiality etc.).

Håkansson and Snehota (1995: 7-10) identify a set of common characteristics of inter-organizational interactions, especially when they turn into ongoing business relationships. Four characteristics are of "structural" nature: *duration/continuity* (meaning that relationships are long-term phenomena that exist over years), *reciprocity/symmetry* (meaning that the resources, power and commitment brought by the interacting parties are typically balanced or at least tightly connected), *complexity* (meaning that relationships include several and multifaceted connections at social, economical and technical level), and *informality* (stressing the prevalence of informal exchange norms, based more on mutual trust than formal contracts and penalties). Four characteristics of business relationships are instead related to their "processes": next to the already mentioned *adaptations, cooperation and conflicts* (stressing how the interacting parties both cooperate and engage in conflicts as part of the normal life of a relationship), *social interaction* (indicating that alongside economic and technical dimensions also personal bonds among individuals are created), and *routinization/institutionalization* (referring to the emergence in established relationships of common norms and routines which might be hard to change).

When inter-organizational interactions move from simple negotiations and transactions to long-term relationships, they assume a "substance" which can be analyzed by breaking down interactions, and especially the ongoing adaptations, into three levels of connections between the interacting parties: *Activity links*, *Resource ties* and *Actors bonds*, according to the so called ARA-model (Håkansson, 1987; Håkansson & Snehota, 1995). Activity links refer to how the two organizations have connected their activities and routines across their organizational boundaries; resource ties to how they have combined their resources such as equipment, products, personnel and competence; and actor bonds to how the perceptions, goals and strategies of the two companies are related (including the issue of mutual trust and commitment). The strength of these links, ties and bonds varies greatly from a relationship to another and moreover, a relationship can present strong actor bonds but weak activity links and resource ties, or vice versa.

Moreover, the strength of links, ties and bonds typically varies over time for one and the same relationship, signalling how it changes and develops (Ford, 1980; Medlin, 2004; and Shurr, Hedaa & Geersbro, 2008). A "relationship development" model proposed by Ford (1980) and elaborated in Ford et al. (2003: 51-8) identifies four development stages ("pre-relationship", "exploratory", "developing" and "stable"), whereby the parties move from low commitment and no common routines to increased mutual learning and trust, built thanks to investments and informal adaptations. However, the model is not deterministic in the sense that one stage must not be followed in a sequence by the next (e.g., exploratory by developing), because the relationship can always revert to a previous stage because of changed requirements, insufficient resources or lack of commitment (Ibid: 51, 56).

The models and concepts from the IMP perspective are particularly adequate when investigating inter-organizational interactions and relationships between industrial customers and suppliers, typically in the form of firms or public organizations (e.g., hospitals or utilities). But the same concepts and dimensions of interactions that we reviewed above (e.g., trust, adaptations, commitment, short Vs. long-term, power & dependence, conflicts & cooperation, routinization/institutionalization, formality & informality) are also highly relevant for university-industry interactions. Nonetheless, university-industry interactions are likely to present different "values" of these dimensions if compared to a typical business relationship between for instance a steel producer and a shipyard. For instance, academic regulations delimits the level of adaptations in administrative processes and rules a university can make for a specific industrial partner, while academic autonomy probably constrains the degree of dependence it can accept in relation to a single firm. Another difference concerns the exchanged resources, which are likely to embrace more immaterial and knowledge-related elements than physical products. Issues such as tightly coordinated activity links (e.g. in JIT arrangements) are also exceptions in university-industry interactions, where the “products” delivered by universities to companies are unlike to enter directly in their routine production activities.

Still, several *dyadic* constructs (i.e., embracing both parties) operate in similar fashion in both B2B and university-industry interactions. For instance, Santoro (2000: 267) found a positive spiraling effect in the development of university-industry relationship whereby the more the tangible outcomes (e.g., publications or patents) and the more intense the relationship becomes. He found instead that the history or length of a relationship is not related to its intensity and depth (Ibid: 268), which are instead more driven by current production of tangible outcomes. Reflecting the interaction atmosphere concept we reviewed above, Plewa and Quester (2007) found that compatible organizational cultures between a university and a company improves trust, commitment and satisfaction in the relationship. Moreover, the barriers to cooperation deriving from diverging motives, time orientation and core values between universities and companies can be easier overcome if trust is built via extensive interactions, especially informal ones (e.g., staff exchange and mixed team building), and if senior management supports and empowers employees operating in the very relationship (Plewa et al., 2005: 449). Another commonality with B2B relationships, is that also in university-industry relationships some of the values created are common to both parties (e.g., new knowledge creation), whereas other values are aimed at mostly by researchers/universities (e.g., obtaining additional funding) or mostly by industry (e.g., direct technology gain or contacts and networks, Ibid: 447).

2.3 The actors involved in university-industry interactions

University-industry interactions, similarly to business relationships (Håkansson & Snehota, 1995) can be complex phenomena, involving several types of actors. As already mentioned in our review of this type of interactions in section 2.1, these interactions involve at least three groups of actors: the *university management* (i.e., the organizational units fostering industrial liaisons and technology transfer), single *researchers* (conducting actual research or education) and *companies*. This three-party game can become even more complicated if other organizational layers within academia intervene, such as the university department employing a researcher (and which may be involved in signing some contracts as it owns the equipment that researchers use in their interactions with companies), or specific units within the company (which become relevant especially for large divisionalized firms, with clear a distinction between R&D and production units).

For the purpose of our study, namely to analyze how university-industry interactions are crafted by universities, while we can consider the company as a single counterpart, it is necessary to consider university management and university researchers as separate parties in these interactions. The main reason is that the roles and the goals of university management are different from that of researchers: the former include Technology Transfer Offices (TTOs) and Industrial Liaisons Offices which do not perform research but are responsible for *diffusing science* to external parties, typically by stimulating and creating interactions with industry; the latter do perform research and are expected to use their knowledge and capabilities while interacting directly with companies. Moreover, the very mission of those offices belonging to the university management clearly includes *crafting interactions between academia and industry*, as a way to diffuse or commercialize science – which is motivated in the US and UK by an attempt to compensate for slower growing public funding (Mowery & Sampat, 2005: 211) and in Sweden by an explicit legislative mandate to universities to support national innovations (Henrekson & Rosenberg, 2001). In order to achieve this mission, TTOs and Industrial Liaisons Offices, both in Sweden and elsewhere, have introduced specific *tools and mechanisms* aiming to identify and contact companies, bring them closer to academic researchers, and foster connections between these two parties, in the hope that this will then lead to actual collaborations (cf. Debackere & Veugelers, 2005: 339).

A key question is therefore: is the university-industry interaction (or relationship) an interaction between a company and the university management or between a company and the researcher? We argue that it is both (cf. Bercovitz & Feldmann, 2006), because there are different layers, levels, dimensions and time horizons in one and the same interaction, making it complex and involving several specific actors (Ibid: 182). For instance, while Industrial Liaisons Offices and TTOs are typically engaged in formal (e.g., negotiations and contracts), long-term oriented but intermittent interactions, researchers typically take part in the informal day-to-day interactions with one and the same company (cf. Debackere & Veugelers, 2005: 325).

In their role and mandate of stimulating university-industry interactions, TTOs and Industrial Liaisons Offices may also actively engage in those same interactions also third parties acting as external financiers or controllers: for instance, National Research Councils or national and transnational innovation agencies, such as the Swedish Governmental Agency for Innovation Systems (Vinnova) or the Swedish Agency for Economic and Regional Growth (Tillväxtverket), all the way to EU-related bodies. Within the Swedish context, the latter agencies have a key role in the emerging university-industry interactions as universities' TTOs and Industrial Liaisons Offices are increasingly financed by them. The presence of external financers for the operations of university management requires the latter to report on the actual outcome of their interaction-enhancing activities, which is made according to a growing variety of key performance indicators, ranging from number of meetings with companies to number of initiated fruitful collaborations (Baraldi, Ingemansson & Launberg, 2012).

As so many different actors intervene in university-industry interactions (TTOs, Industrial Liaisons Offices, public innovation agencies, companies, university departments and single researchers), they all bring into the process their different *perceptions* and *assessments* of the interactions between the two focal parties, the researchers and the companies. Each actor evaluates in its own way the results and effects of these interactions, typically informally and according to own idiosyncratic preferences and experiences. However, these evaluations are becoming increasingly explicit and formalized, in the form of KPIs (Ibid). These *formalized evaluations* are in focus in our investigation of university-industry interactions. In fact, it is especially the "crafted" interactions, that is, those externally stimulated by the intervention of university management, that are exposed to being monitored and evaluated in increasingly formalized way, just because specific tools have been created and investments (often via external funding) have been made to foster them. KPIs become thus a way for university management (and also higher up in the policy making/implementation hierarchy) to measure the performance of TTOs and Industrial Liaisons Offices in terms of ensuing university-industry interactions. However, KPIs represent the university management's perception and assessment on these interactions, which may or may not be aligned with the perception and assessment of the involved researchers and company. This is indeed one of our research questions, namely investigating differences and similarities in the assessment and measurement of university-industry interactions made by the different actors involved.

Based on this theoretical review, our theoretical frame, depicted in Figure 1, includes *three main actors* ("university management", "researcher" and "company") and focuses on the *interaction* between (1) "researcher and company", but also includes the interaction (2) "university management-company" (the two thick arrows in Fig. 1). University management devises and applies specific *tools* (such as AIMday and SMURF, the two cases analysed in this paper), which have the specific purpose of *stimulating, shaping and crafting interaction* nr (1), but also possibly nr (2). These tools have also built-in *KPIs* applied by university management as a way to measure and steer the creation and development of university-industry interactions. These KPIs reflect and focus on several types of effects and results in these interactions (see the single-headed arrows in Fig. 1), which can be related to the interaction dimensions taken from IMP studies (depth, duration, adaptation, cooperation, values created). However, the company and the researcher may have different goals, perceptions and assessments on their mutual interactions than those included in the KPIs applied by the university management.

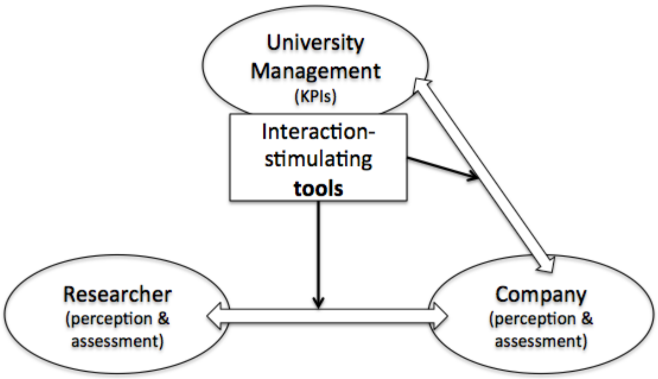

Figure 1: A three-party framework over university-industry interactions

3 Methodology

This paper relies on a comparative case study methodology (Yin, 1994), based on two cases over two different interaction-stimulating mechanisms, AIMday and SMURF, devised and applied by Uppsala University. As the two cases are extracted from the same organizational context, they reflect an "embedded case" method, which is viewed as particularly useful in unravelling the complexity of inter-organizational interactions and networks (Easton, 1995: 480). The two cases where selected according to a theoretical sampling logic (Eisenhardt & Graeber, 2007: 27), since our approach is exploratory and we do not aim at a statistical, but at analytical generalization (Yin, 1994): in fact, these two innovation-stimulating mechanisms address *different types of university-industry interactions*, which are one of our key theoretical concepts and relate with our paper's purpose of identifying a typology of such interactions.

More precisely, AIMday is a tool stimulating researchers and industry to meet, often for the first time, unconditionally and simply discuss topics that interest both parties with the purpose of *initiating* any type of interaction, no matter their depth. The purpose of SMURF purpose is instead that companies and researchers build collaborations on a joint project with concrete outputs. The two cases display accordingly different KPIs, another of our key theoretical concepts. Therefore, the two cases are complementary from a theoretical point of view. They are moreover *comparable* because they are not only embedded cases sharing the same context, but they have also been constructed following a common data collection logic searching for the same theoretical issues (nature and process of the applied innovation-stimulating tool, actors involved and their perceptions and assessment, as well relevant KPIs).

Our empirical materials (see Appendix) was collected between 2010 and 2012 by means of several sources of data: *participant observations* to 6 AIMday events (including active participation to the discussions in 4 AIMdays) and to all 17 project and steer group meetings of SMURF (as two of the authors act as "ongoing evaluators" of this project); over 40 *qualitative interviews* conducted with representatives of UU Innovation, ÅMA, UUAB, SLU Holding, and several companies and researchers involved in AIMday and SMURF; an online *surveys* distributed to 30 SMURF companies, 15 of whom answered and among which three were selected for in-depth interviews (see Appendix); *documents* such as brochures, official applications, internal reports provided by university organizers, researchers and companies. We view our data as sufficiently rich to cover the multiple aspects of the phenomenon we investigate. As for AIMday for instance, all persons involved in developing and organizing the event have been interviewed on several occasions, while for SMURF interviews were conducted with all members of the project group at least twice, and with some key persons even more often.

The main themes in the interview guides we used with representatives of the university management (UU Innovation, ÅMA, UUAB SLU Holding) were the organization and process of the two interaction-stimulating tools, their goals, effects and key performance indicators, as applied by the university management. The interviews with companies and researchers covered instead the actors' perception of the interactions and effects created by AIMday and SMURF, with a focus on how these interactions are evaluated by these actors.

One of the first steps in the analysis of the empirical material was to build the two cases. However, while the cases were built with a similar structure (background, organization and process for creating university-industry interactions, perceptions and measures/KPIs), as a way to enable a straightforward comparison, it became then evident in our ongoing analysis that they were indeed more *complementary* than simply comparative. In fact, they provide variation and overlap in the types of interactions featured rather than pure differences. Therefore, our next step of analysis was searching *across both cases* for different types of interactions, based on the theoretical concepts above (mostly the ARA model, but also depth of interaction, level of adaptation and type of exchange). From this search, four types of interactions emerged immediately, while the fifth type ("contacts") emerged only when building a descriptive model over Uppsala University's process for crafting various types of interactions. Therefore "contacts" have not been included as a type of interaction per se in our typology, but are kept more as a sort of "potential" interaction, which contributes to the *movements* between different types of interactions in the model. We developed this model after applying our typology of four/five interaction types back to the two cases, which we at this point considered even more explicitly jointly and as complementary aspects of Uppsala University's approach to crafting interaction with industry. Finally, our analysis of the perceptions and assessments of the various actors was made first case by case, and then over the two cases jointly, as it appeared that the actors focussed on different but complementary types of interactions in each of the two cases.

4 The cases of AIMday and SMURF at Uppsala University

The empirical material starts by presenting the common background to the two interaction-stimulating tools AIMday and SMURF (4.1), then focuses on the specific background, process, perceived results and measurements of AIMday (4.2) and SMURF (4.3) respectively.

4.1 Uppsala University's history of interacting with industry

Uppsala University was founded in 1477 and has probably always interacted with its surroundings through different constellations. Since the 1970's Uppsala University has had an Industrial Liaison Office, which however did not perform as expected. Nevertheless, the university's contemporary interaction strategies, especially aimed at industry, did not start to take shape until the year of 2000 when the Swedish Foundation of Technology Transfer decided to place the Industrial Liaison Office as a subsidiary to the university's holding company (UUAB) in an attempt to improve the liaison office's performance. The reorganization also meant that all personnel were replaced by a new manager that had a long industrial experience.

The new manager of the Industrial Liaison Office quickly perceived a negative view, wide spread throughout industry, when it came to collaborating with universities: researchers did not deliver in time and when they did it was rarely what had been agreed upon. This problem needed to be solved in order to enable the liaison office's mission. The manager found a group of researchers at the university's Materials science division that seemed to have overcome the problem as they had established relationships and frequent collaborations with industrial partners. In 2002, the Industrial Liaison Office, together with professors of the Materials division formed "Ångström Academy", an organization aimed at creating university-industry collaborations using the Materials researchers' experience. Ångström Academy succeeded in launching a few collaboration projects. Therefore, in 2004 the Swedish Agency for Innovation Systems (Vinnova) offered Ångström Academy 100 000 € for being part in a one-year pilot project for the so called Key Actor's Program. This national program aimed to facilitate general "cooperation" between academic research, industry and society through the creation of a professional infrastructure and entrepreneurial culture within the universities. Ångström Academy had experience in interacting and even concretely collaborating with industry, and therefore acted as a reference group to Vinnova's discussions on how to shape a program for university-industry cooperation.

In the year 2005 new directives came from the Swedish government demanding a "Plan of action" from the Swedish universities on how they would support the commercialization of academic research. Together with UUAB and the Industrial Liaison Office, Uppsala University management formulated an action plan that did not only involve traditional technology transfer, through the licensing and creation of new companies via patents, but also an alternative "proactive" approach emphasising the utilization of science by crafting closer and long-term interactions with companies. The action plan later became an important part in the university's application, submitted in 2006, for Vinnova's 8-year-long Key Actor's program. The application emphasised and described a new innovation support unit, placed directly under the University management and closely related to the holding company, which aimed to develop platforms that facilitated university-industry cooperation.

In 2007, this unit, named Uppsala University Innovation (UUI), started its operations and, with its five-year history and a few established relationships to industrial partners, Ångström Academy, renamed "Ångström Materials Academy" (ÅMA) became UUI's first academy-industry cooperation platform. Today ÅMA is more than simply a platform to stimulate general cooperation, because it is an organization of its own with members, from both industry and Uppsala University, all paying an annual fee. ÅMA assumes the features of an alliance between selected industrial partners and Uppsala University, with a board composed of representatives from five of Sweden's largest corporations in the steel and power industries, from three of Uppsala University's research departments and from the University management.

4.2 AIMday

UUI is responsible for the university's cooperation efforts, generally speaking, designed to foster economic growth in the society (www.uuinnovation.uu.se). These efforts are promoted primarily through strategic cooperation platforms, like ÅMA, in which physical meeting places are arranged, where academic researchers and representatives from industry meet. It is a proactive approach in that it promotes academic-industry interaction prior to, or irrespectively of the disclosure of a commercially potential scientific discovery. Instead it strives to facilitate the creation of *long-term academic-industry relationships* by involving industry in academic research and vice versa. The idea is that academic research is more directly utilized in this way, in addition to the linear commercialization process provided by the University's holding company. One physical meeting place arranged by UUI is AIMday (Academy Industry Meeting day), which in practice is a one-day conference where academic researchers and industry meet to discuss issues formulated by the participating companies. The conference was developed by ÅMA, which however, as already mentioned, had already been running for five years as Ångström Academy and had industrial partners closely related to it. Nevertheless, from its start in 2007 ÅMA was not a finished concept as it still lacked tools that efficiently could promote additional forms of university-industry cooperation.

4.2.1 The background of AIMday

It would take a study visit to Massachusetts Institute of Technology (MIT) in Boston to formulate the concept of ÅMA. During the study visit the UUI managers were briefed about a conference called the "Materials Day" where researchers and industry presented their latest research and work in seminars and during which innovation awards was granted to innovative researchers. The idea was to create something similar within ÅMA, which was an assignment given to the manager of the platform. According to the manager, it was not enough with traditional presentation where academic researcher and industry presented their work to each other since these kinds of meetings rarely where efficient to promote the creation of university-industry cooperation or even more concrete collaborations. The reason for this, according to the manager, is that meetings in terms of traditional presentations are strongly affected by barriers hindering academic researchers and companies to find each other, as they do not fully understand and grasp each other. Researchers tend to go into detailed technological aspects, while industry is more interested in getting something to work, good enough, and make it profitable as fast as possible. Researchers also tend to use technical research terms that industry does not understand.

Thus, to make ÅMA's concept as effective as possible and overcome barriers like these, ÅMA's manager chose to divide the "Materials Day" into different activities running at different occasions during a one year period. The traditional presentations were transformed into lunch seminars where people with different backgrounds give a presentation for researchers and other actors that choose to attend. Once a year innovation awards are granted to Uppsala University researchers connected to materials research that has proven to develop commercially valid research. The third main activity, AIMday, became the key component for the facilitation of university-industry cooperation as it, according to the UUI and ÅMA managers, make researchers and companies meet on equal conditions by focusing on industrial problems and issues instead of progress within research. In addition to these three main activities ÅMA focus on connecting the university's education with industry through, for instance, finding student projects within companies.

Since its starting point in late 2008, AIMday has spread to other research areas than Materials sciences via UUI's other two cooperation platforms focused at Life Sciences and Humanities and Social sciences (HumSam) respectively. AIMday has also successfully attracted the interest from various actors in what can be term as the Swedish innovation system. As a result, AIMday has become a very important interaction-stimulating tool for UUI.

4.2.2 The process behind AIMday

AIMday is a one-day conference composed of a number of workshops running in parallel. In each workshop a company, together with a multidisciplinary group of academic researchers, discuss a question or issue formulated by the company. According to the managers, a multidisciplinary group of researchers is important to generate more than one view on the issue at hand. All companies that associate themselves to the theme of the conference are welcome to participate as long as they submit at least one question. For each AIMday, the organizers put a lot of effort in marketing the event and its topic to receive questions from industry. According to the managers, this process requires both a good knowledge about different companies' operations and a good contact network with industry. When questions from industry are received, researchers with knowledge or interest in the topic can register their participation to the questions at hand. Researchers from all universities are welcome.

However, for the organizers it often takes hard work in terms of pitching the questions to make them both understandable and interesting for the researchers. Organizers often need to contact researchers they think have knowledge in the question to get some feedback about his or her perception of the question. Thereafter, the organizers contact the company responsible for the question and discuss how to pitch it to the researchers without losing its meaning to the company. This often requires some knowledge around the topic from the organizers themselves. When all questions finally are pitched the organizers still often need to contact researchers, whose competence they feel fits the questions' different topics, to simply ask or remind them to register, as the researchers often prioritise other work than their participation to AIMday. For this, a good contact network between the cooperation platform managers and researchers is needed. According to the managers a workshop group should consist of 1-3 company representatives and 6-10 researchers ranging from PhD students to professors and should not last for more than one hour. This approach is important to get a rewarding discussion that focuses on the issue at hand. As soon as all questions from industry have been submitted and researchers have started to register, a schedule is outlined, fitting with both companies that have submitted and researchers that have registered to more than one question. The schedule is based on a number of sessions comprised of a number of workshops each.

From start, AIMday was organized by ÅMA once a year and aimed at industry and university research connected to the area of Materials science. However, the activity soon started to spread to other research areas: AIMday is now a key component in all of UUI's cooperation platforms, and has been adopted by other Swedish universities. The rapid evolution and expansion of AIMday created problems for UUI. They feared that the concept would become diluted and lose its attractiveness for industry and researchers, as it would transform when moving between different organizers and scientific areas. Thus, UUI has chosen to protect the AIMday concept by trademarking it and formulated guidelines specifying how an AIMday should be organized and operated. Today, other universities than Uppsala University have organized "their own" AIMday in areas like Energy, Sustainability, Image analysis and Patient safety, while UUI can keep control of its usage. AIMday continue to spread as an interaction-stimulating tool across actors belonging to the national innovation system and in 2012 an AIMday-organizing-committee was created, comprised of a number of support organizations belonging to different Swedish universities. Figure 2 shows the actors involved in AIMday.

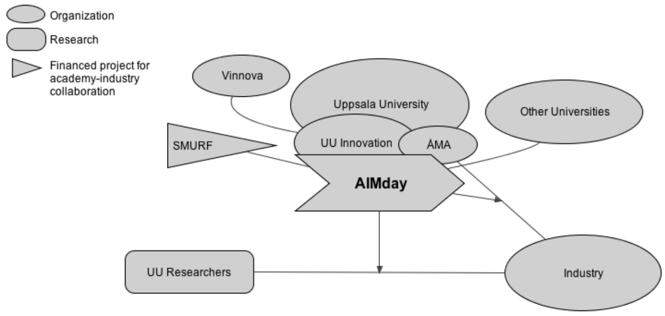

Figure 2: The different actors involved in AIMday

4.2.3 Perceptions and results of AIMday

The overall objective of AIMday is not to give answers and/or solutions to industrial problems, but to bring together companies and researchers and thereby stimulate cooperation during rewarding discussions, which might even open up for the creation of concrete university-industry collaborations in the future (aimday.se). AIMdays have been run 16 times in total, since 2008: on average these AIMdays involved 15 companies with 35 representatives and 70 university researchers in about 25 discussions of the submitted questions. An interesting question is what AIMday has resulted in, when it comes to concrete outputs and other effects for the involved parties? Even though AIMday has led to a couple of dozen small university-industry collaborations, this is not what the majority of participants stress as the most important value emerging from the meetings.

Researchers emphasize that the discussions generate mutual knowledge transfer between academy and industry. In other words, discussing industrial issues and problems broadens the researchers' competence by learning from the "real world". Thus researchers also feel that they can reframe their research agenda to better fit industrial needs. Having a research agenda fitting industrial needs opens the possibility to find collaborations and to be granted funding, and AIMday works as a shortcut for researchers to find favourable industrial contacts. Researchers also emphasize that AIMday promotes learning from other research areas, as the workshops are comprised of multidisciplinary groups of researchers. Another important aspect with AIMday, emphasised by the researchers, is that the activity makes a good opportunity to market and sell the actual use of laboratory equipment to industry.

Companies emphasize the value of expanding their network of contacts with academia, by getting to know new researchers, and strengthening their current relationships with those they already know. A common perception for the participating companies is also that there seldom is a direct utilization of science to solve a concrete industrial problem. Instead they underline that, through the discussions on AIMday they can expand and deepen their understanding of a problem, which can save them both money and time. Most companies also feel that researchers are very good at providing insights on new relevant literature and key articles on a certain topic. Another important value expressed by industrial participants is that AIMday opens the opportunity to utilize new analytical methods, tests and laboratory equipment, which are resources most companies do not possess in-house.

AIMday is a key component in UUI's mission to facilitate the diffusion of science to society. Thus, it is essential for the unit to be able to control and measure what the activity contributes to in terms of concrete outputs, like collaborations, as an indicator of the utilization of science. As one of the UUI managers expresses it: *"One day we will get the question of what our activities, e.g. AIMday, actually has contributed to and we will have to be able to show concrete results"*. Looking at more concrete effects of AIMday, both researchers and industry identify that via their participation they more easily keep in contact with current research partners and also can get inputs for finding new ones. Industry thinks that several interesting and highly relevant ideas are generated during the workshop discussions, but due to time constraints and other prioritization within industry (and probably also academia) the great majority of ideas are not followed up and simply wane out.

However, some collaboration between researchers and companies has been initiated as a result from the meetings at AIMday. Still, the greatest majority are short-term and small projects whereby a company is helped with some kind of analysis through testing and measurement via the use of university equipment. If these collaborations actually are a result from AIMday and what they actually contribute to is difficult for UUI to quantify, as they often are initiated a few weeks, or even moths, after the AIMday event, when participants have had time to contemplate on all meetings and discussions. In an attempt to boost the creation of collaboration projects at AIMday, UUI has chosen to offer pre-study grants via a project called SMURF (described in greater detail below) to promising projects initiated at AIMday. The hope is that a small grant of 5.000 Euro, will be enough to initiate a pre-study that can further develop into a full blown collaboration. This approach has generated around 5 university-industry collaboration projects that are, at least, in a pre-study phase.

4.2.4 Multifaceted measures oriented towards long-term interactions

Both researchers and companies participating on AIMday emphasise that the main value of AIMday is "networking for networking's sake". In other words, AIMday seems to foster the opportunity to expand, strengthen and deepen their network of contacts for future needs. The participants do not prioritize finding answers, solutions or collaborations when attending AIMday, but the creation of an open channel through which they easily can find and use each other when issues may arise in the future. However, since UUI operates mainly through third party funding (e.g., from Vinnova), it needs to be able to measure concrete effects and outputs from AIMday. But this has proven difficult, as researchers' and companies' priority about networking for longer-term purposes has not always resulted in "hard" and easily quantifiable outputs – especially outputs indicating a direct utilization of science for industrial development and national economic growth. Even though UUI's external financing pressurizes them to produce traditional short-term effects, they are well aware that when it comes to the utilization of science through university-industry interaction a long-term approach is needed. Measures and indicators of various sorts have nonetheless emerged in the operations of UUI, especially when it comes to AIMday: these indicators concerns quantifiable direct results such as the number of participants and questions discussed, the number of university-industry collaborations, but also softer aspects such as if participants feel that they found new contacts and their overall impression of AIMday.

At present UUI applies the following indicators, which have all progressively emerged and are gauged via surveys and internal records, in order to evaluate informally AIMday: number of AIMdays, number of questions submitted, number of participating companies, number of participating researchers (PhD and senior faculty respectively), number of participating research divisions, number of participating universities, number of participants who created new contacts, number of participants who developed new knowledge about the topic(s) discussed, number of participants who felt the discussion were relevant for their future work, participants' overall impression of the AIMday and willingness to attend to it again, number of joint applications researcher-company to get funding for pre-studies (via SMURF), number of collaborations initiated via AIMday.

4.3 SMURF

SMURF is a joint project between Uppsala University and the Swedish University of Agricultural Sciences (acronym in Swedish, SLU) running between 2011 and 2014 with the aim of enhancing small businesses' development and long-term survival by improving their relationships with the universities of Uppsala. The target group are companies within Life science, Material sciences, Sustainable technologies and in the knowledge-intensive social science service sector. These industries were chosen to reflect and match the expertise of UU's and SLU's researchers. The focus is however on companies with high growth potential but with limited resources and thus perhaps greatest need for support from the universities. The project aims to create a platform that facilitates and finances *collaborations* between a SME (small and medium sized enterprise) and a researcher manifested in concrete research projects. SMURF has 22 million SEK (about 2,2 million Euro) available to distribute to such collaborations during a timeframe of three years. Half of this sum is provided by Swedish Agency for Economic and Regional Growth (Tillväxtverket, TvV) and half "in kind" by the two organisations operating the SMURF platform, UU Innovation and SLU Holding (whose tasks are similar to those UUI, even if it is smaller in size).

4.3.1 The background of SMURF

According to UUI one of the most important factors for a sustainable economic growth is the region's knowledge-intensive SMEs. The two universities in the Uppsala region can provide knowledge to these firms, but are today an untapped source for the regional

SMEs. In fact the most of these companies lack contacts and, even more, long-term relationships with universities, since these companies basically have no capability to fund basic research. Uppsala has not only one but two universities, SLU and UU. SLU has a different research profile than UU, with the largest part of its research and education based in Life science with an emphasis on agriculture and ecology. UU Innovation's conviction was that by also including SLU in the SMURF-project the uptake capacity of SMEs will increase, while broadening the scientific expertise within the project.

UUI and SLU Holding, the unit within the universities' management which operate the SMURF platform, comprise of employees with experience both in industry and in academic research. Hence, their staff's know-how, expertise and contacts are essential in carrying out several tasks and separate projects, most of which are financed with external capital, all aiming to diffuse or commercialize academic research. In the case of SMURF, Tillväxtverket (TvV) is the main financier. The role of the governmental agency TvV is to strengthen regional development and facilitate enterprise and entrepreneurship throughout Sweden. The agency is beneficiary of large financial resources from the European Union's structural fund, intended to reduce the economic and social differences between European regions and its inhabitants. TvV funds SMURF with 11 million SEK and expects that this project will reach a clear goal in terms of regional growth, 20 new employment opportunities.

The explicit goal of SMURF is strengthening SMEs' sustainable economic growth through increased interaction with the region's two universities: this interaction is meant as collaborations within research projects involving smaller companies and researchers at UU and at SLU, as well as the establishment of new contacts between the various partners involved in the SMURF-project.

4.3.2 The organization and the processes within SMURF

Including the coordinator for the entire project, there are seven project managers working with SMURF, five employed by UUI and two by SLU holding. They have higher academic degrees in the areas covered by this platform. The UUI employees are also involved with AIMday enabling a connection between the two interaction-stimulating tools. Each project manager deals primarily with companies within her area of expertise and experience. SMURF follows a loosely structured work procedure that starts with rallying SMEs to the project via information activities aimed at getting them in contact with UUI, SLU Holding or SLU and UU researchers. There are two basic ways in which companies are brought into the SMURF platform: (1) information activities that can range from spreading information about SMURF out to relevant actors (via e.g., the homepage) to informing about SMURF during a specific AIMday; (2) personal contacts taken from the project managers' large network of connections with companies, if these were considered to fulfil SMURF's requirements and needed to have a problem solved which could be interesting also for an academic researcher.

Engaging a researcher to interact with an SME in a specific collaboration project can follow two different paths: (a) a researcher and an SME have made the connection on their own, for instance through an AIMday, so that the researcher already has an interest in the project; or (b) the project managers exploit their knowledge of the university organisation and scientific areas and asks a specific department or even individual researcher if they are interested in the problem or need expressed by the SME. If the SME is brought in without any prior relationship with any researcher at all, there is often the need to re-formulate the initial problem specified by the SME as to establish sufficient research height so as to be able to engage a researcher.

An application to SMURF's funding can be disqualified for several reasons, one being conflicts of interest, such as ownership of the SME by UU's holding company (UUAB), as a way to avoid funding own spin-offs. Another reason for disqualifying an application is if it is obvious that the SME and the researcher have had a previous relationship with one another, since one of SMURF's goal is to stimulate only *new* collaborations.

After the SMURF project group has agreed that a collaboration project fulfils the formal requirements and has potential to bear useful results to the SME, a project manager from UUI or SLU Holding, the researcher and the SME, cooperate in order to write together a project plan that fits all of their different agendas: The proposed collaboration project has to be relevant for the researcher in a way that is both interesting and useful for her research. It has to specify how and in what way the SME will benefit, namely that a need is met or a problem is solved. Lastly, SLU holding or UUI has to verify that a project plan for the collaboration is specified in such a way that it both fits the regional growth goal of SMURF (20 new employments) and helps reach a set of specific, more detailed key performance indicators stipulated for SMURF platform (see below).

When a collaboration project application is formally approved by the SMURF project group, UUI and/or SLU Holding are no longer involved, except for occasional follow ups through e-mails or phone calls concerning how the collaboration project is progressing. Collaboration between one of the universities and the company is accordingly formalized in the project, which receives financial aid from SMURF. However, no financial flows move from SMURF (or Tillväxtverket) to the SMEs. SMURF pays instead invoices coming from the involved university departments including the following costs: the salaries of the academic researchers working in a specific collaboration together with the SME, as well as other material costs or laboratory rent. Each individual collaboration project can be financed either as a smaller "pre-study", receiving a maximum of 50.000 SEK (about 5.000 Euro), or as a larger "full project", receiving a maximum of 300 000 SEK (about 30.000 Euro).

The invoices from the researchers' own department are the main formal mechanism used by the managers of the SMURF platform to follow up on single collaboration projects. Upon its conclusion, the SME and the researcher summarize the collaboration project's proceedings and results in a final rapport, stating also if the value for the actors has been achieved according to the project plan. At this stage, the SMURF project managers in charge of a project inquires if the SME can apply for additional funding for continuing the collaboration with the academic researcher, either within SMURF (if the first collaboration was a “pre-study”) or some other type of funding from regional or national agencies. The activities conducted after a collaboration project’s completion are termed by SMURF managers “networking”, and are viewed as a pivotal component of SMURF. In this context, “networking” is specified from the project managers as either a deepened relationship with the same researcher that has been collaborating with the SME or the SME applying for additional funding with a new contact from the universities or for some other financial support scheme that requires R&D connected to a university.

All in all, the process within SMURF follows a work procedure going from (1) finding SMEs that participate in some kind of information meeting, (2) engaging them and (3) formalizing a collaboration project with a researcher. There is then hope that this collaboration project can establish a deeper relationship that over time can result in such results as scientific publication, technical developments for the companies or even new employment opportunities for the company. Figure 3 shows the actors involved in SMURF.

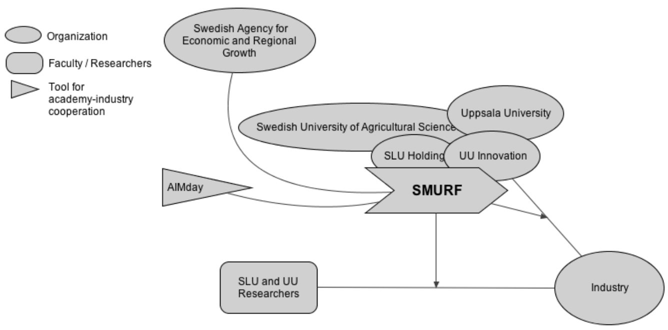

Figure 3: The actors involved in SMURF

4.3.3 The effects and the value of the SMURF platform for the actors involved

As of February 2013, over 500 SMEs had participated in various information events promoting SMURF, about 50 had applied together with a university researcsher for project funding, and about 30 collaboration projects had been approved by the SMURF project group and started.

The researchers involved in SMURF attribute several values to engaging in a project with an SME. Some consider as valuable the fact of evaluating their expertise in real-life case studies and of getting relevant industry related examples for students. Some other stress the value of establishing a long-lasting and deep relationship with relevant industry and at the same time of being able to create good connections for their student master-theses with the business community. Some researchers also express that collaborating with firms within SMURF is a relevant way of fulfilling the “third mission” attributed to Swedish researchers, more so than other activities because SMURF collaborations provide them with a more direct return. More precisely, researchers involved in such collaborations view as very important obtaining financial compensation for the time spent working with the SMEs. In this sense it should be stressed that SMURF collaboration projects appear as relevant both for their own research and for a financial return.

Differently from the researchers involved in AIMday-stimulated interactions, the researchers interacting with industry via SMURF seem to prefer the strict and steered form of SMURF collaborations, with a clearly stated start and finish, rather than a more loosely open ended discussion with an industry partner. However, one must have in mind that AIMday is different from SMURF in many ways, as SMURF requires a greater commitment and longer duration of interaction from the researcher, while AIMday is per se a one-day only interaction event.

The companies involved with SMURF stress also a variety of values deriving from these interactions with researchers: they can get new perspectives on the problem that they together with the researcher work on; some of the SMEs involved with solving a technical problem get access to lab equipment through the project which they would never afford; many companies also consider that by connecting a researchers to their business they can increase their reputation. Moreover, the SMEs express how useful it is to have the chance to work with a researcher without taking the risk to spend their own resources, as especially the small or micro firms would never hire an external agent as it would be too expensive regardless of the value of the project.

In sum, it seems as the value of SMURF for the SMEs are twofold: firstly, it is very important that the there is a clear goal to work with so that the pay-off of collaborating with a researcher is evident. Secondly, the companies also expresses the importance of establishing a good and deep connection with an expert from a university, that is, someone to “put on the shelf” and use later when there is a need for it, or someone to use as a reference when doing a sales pitch towards possible investors.

As for the companies’ expected contribution of working with a researcher towards employing more staff (the underlying goal of SMURF), most companies are sceptical: they cannot at present forecast if working with a researcher will enable them to employ more staff. Furthermore as the target group are SMEs and some of the companies are very small, with several only having one or even no employees, it is highly unlikely that they will employ anyone in the short time-span of the SMURF-project.

Differently from AIMday, UUI and SLU Holding defined from the very beginning an explicit set of *key performance indicators* for SMURF, which were also formally approved by the funding agency TvV. The very goal of the whole triennial SMURF project (creating 20 new employments in the region) is accordingly related to more specific indicators representing more specific effects of utilization of science, such as number of fruitful meetings between SMEs and academic researchers. SMURF’s project managers direct their marketing and information efforts to fulfil some of these indicators: for instance, they can choose companies that they think will, with the help of an academic researcher, succeed in reaching such indicators as collaborations within the Life science area, patents or publications.

However, the main goal of SMURF is expressed in terms of industrial growth, which makes it very difficult for SMURF's project managers to direct their efforts to accomplish it. The same holds for such other indicators as patents. It will always be the other actors, and especially the SMEs, who have the direct power to act in such a way that the overall goal or specific indicators are met. As stated by one of SMURF's project managers working at UUI: *"These types of project will have effect later, it is incredibly hard to measure those types of effect in such a short-sighted project. The preferred type of goal would be to have a focus on establishing a contact area between companies and researchers."*

Nonetheless, this quote indicates that UUI sets a high value in the very *tool* of SMURF: it enables in fact to establish a contact between a SME and a researcher regardless if the performance indicators are reached or not. To accomplish this, to strengthen the SMEs via a contact with a researcher from UU or SLU, fits well with UU Innovation and SLU holding's overall missions in their undertakings of diffusing academic knowledge. However, it should not be forgotten that the SMURF-project per se will be eventually evaluated by an external party, Tillväxtverket, with a focus on how well the project has exploited its financial means for meeting its overall regional development goal and the specific KPIs reviewed below.

4.3.4 Specific measures of university- industry interaction

The main goal of SMURF is creating 20 new employments, a KPI intended to show economic growth within the SMEs enrolled in the project. This goal has been set by UUI and SLU Holding in concert with Tillväxtverket, the main external financer of SMURF, to measure how the SMURF-project has contributed to economic growth within its three-year timeframe (2011-14). Therefore, UUI and SLU Holding are externally accountable for reaching this growth goal. Moreover, these organizations also defined a more specific set of goals more directly connected with the diffusion and utilization of science, as expressed in the following KPIs:

Number of SMEs met in information purposes	200
Number of participants in different events (AIMday, SME meetings etc.)	
- Companies	50
- Researcher	200
Number of fruitful meetings between SMEs and academic researchers	42
Number of project initiated after AIMday or similar meetings	42

Number of project/companies conducting networking activities as a result of participating in SMURF	10
Number of patents and scientific articles with the academic researcher as well as employees in an SME listed as authors/inventors	10

These KPIs also reflect the process applied by SMURF's project managers in their daily work of engaging researchers and SMEs. First, there is the initial information towards SMEs for the purposes of laying the foundation for cooperation and collaboration via fruitful meetings and/or SMEs participating in AIMdays. There is then a KPI specifying how many collaboration projects SMURF should accomplish, representing the next step in SMURF's process. As of February 2013, the first two KPIs in the list above had been easily reached. Reaching the 42 "fruitful meetings" is also soon within the project managers' grasp, which also holds for the closely related goal of creating 42 collaboration projects between academic researchers and SMEs.

The two last KPIs, "networking activities" as well as "patents and scientific articles", can be viewed as forms of interactions that are closely related to a deeper researcher-company relationship. In fact, with "networking" SMURF managers mean the fact that a researcher and a company proceed after the completion of the SMURF-financed collaboration project and search for additional funding for continued collaborations. Like co-publishing and co-patenting, networking entails increased interactions, with deeper connections in the involved resources compared to a short-term collaboration project, such as the 42 which are SMURF's goal. These last two KPIs, as well as the overall goal of 20 new employments, have not yet been reached and are the object of growing concern within the project management group as to if they will be met by the end of the SMURF project in 2014.

5 Analysis and discussion

We now analyze our empirical materials in order to answer the four research questions that we raised in the Introduction about the types of interactions that Uppsala University has with industry, how this university operates to craft such interactions, how they are perceived and measured by the involved parties, including the differences in their assessment. Our discussion relies on the concepts we introduced in the theoretical framework (the three actors involved in university-industry interactions, the KPIs applied and the effects in terms of type of interactions obtained), which are now applied to the two cases. We start from discussing the first question in order to build a typology of interactions visible in our empirical materials and then move to the other three research questions.

5.1 A typology of university-industry interactions

The AIMday and SMURF cases illustrate how Uppsala University interacts with companies in many different ways. A first type of interaction actually pre-existed the introduction of these two interaction-stimulating tools: these interactions are the *long-term, deep relationships* which connect some of Uppsala University's Departments with five selected companies within ÅMA (Ångström Materials Academy). These interactions are *long-term* in the sense that the companies involved with Uppsala University signed agreements oriented to the long-term, as they became members of an association such as ÅMA. The same interactions are also *deep* because they have a wide range of contents that embraces most of the typical mechanisms to diffuse science: sponsored research, industrial PhDs, joint board participation, equipment and laboratory access, student degree collaborations etc.. These interactions are deep also because they involve several interfaces from both sides of the relationship: the university management, namely UU Innovation and the project managers who drive ÅMA on a constant basis, several departments of Uppsala University and many individual researchers, next to several individuals from the company's side. Finally, this type of interaction can be qualified as a true *relationship* (Håkansson & Snehota, 1995) because it has a *history* filled with several recurring interaction episodes in the past few years, which have led both parties also to make *adaptations* (Håkansson, 1982: 19) clearly manifested in the creation a joint organization such as ÅMA.

Interestingly, these types of long-term, deep relationships are not only part of the background leading to AIMday and SMURF, but they are also the type of interactions which the university management expects these two tools will create in the future. However, at the time of our investigation, the interactions crafted by the two tools are of a few types which are different from true relationships. First of all, AIMday appears to be an efficient tool in generating two types of interactions: *participation* ("med-verkan" in Swedish) and *cooperation* ("sam-verkan" in Swedish). "Participation" refers to those meetings where both researchers and company representatives "participate", in the sense that both parties are present together: this type of interaction is however rather weak, as the counterparts might exchange nothing more than a superficial acquaintance, in the sense that they get to know each other but no resources are exchanged or activities conducted in concerted ways. The interaction type "participation" involves both single researchers, whom companies get to know, but also the university management, as they are typically the arrangers of the events wherein the meetings, which are the minimum requirement for "participation", occurs. In this sense, also the SMURF tool contributed in its early stages with events to which it invited several SMEs and generated therefore participation-type interactions.

"Cooperation" is another type of interaction which appears through both SMURF and AIMday: its main feature is that it involves some form of *action conducted together* towards a goal, which might or not be shared by both the company and the university representatives, be it researchers or administrators. At its most basic level, this joint action is information exchange, such as the discussions conducted in AIMday's closed meetings, whose goal is to address the problem suggested by the company, even if researchers might be oriented to entirely different goals, such as finding funding for own research. Also the SMURF tool entails "cooperation", such as when researchers and companies discuss together and jointly formulate the project applications to the SMURF project group. "Cooperation" is accordingly a deeper form of interaction than "participation", even if the activities involved are only of communicative character and the resources exchanged are mostly information and knowledge.

The next type of interaction, *collaboration* ("sam-arbete" in Swedish), is stronger than "cooperation", but it is widely visible so far only in the SMURF case, and appears more seldom and mostly indirectly in the AIMday case. It is in fact a key feature of SMURF to match researchers and companies and have them conduct a joint research project, entailing a common goal which is at least formally accepted by both parties and which entails conducting some form of work together. This work is also of practical character and includes also activities such as research, testing, prototyping, that is, not only communicative activities. Next to information and knowledge-related resources also physical ones such as laboratory and equipment can be involved, next to financial ones which assume a central place as a large amount of time or other resources is dedicated to each other and need to be paid for.

As mentioned "collaboration" is a deeper type of interaction than "cooperation", but it is not yet the same as a full-blown relationship. The reason is that "collaboration" might be a rather short-termed phenomenon, such as a project lasting only a couple of months, without being followed by any other episode. "Collaboration" typically generates tangible outcomes, such as a prototype for a new product or key inputs for a company's R&D, but it stops at the moment when the parties receive these outcomes. It is only when other interaction episodes follow each other, either several cooperation or even several collaboration-episodes, that we can trace the emergence of a real relationship. And the presence of positive tangible outcomes coming from a specific collaboration in progress is recognised by the literature as one of the main reasons for repeating interactions in such a way that can create a long-term and deep relationship, even more than the previous experience of interaction between the two parties (Santoro, 2000: 267).

In summary, the four typologies of university-industry interactions that emerge from the analysis of our empirical materials are, in order of increasing depth and long-term orientation:

› *Participation* ("med-verkan"): is the simple taking part to a meeting and getting to know each other. It is typically very short-term and only if the contacts created are turned into one of the interaction forms below "participation" leaves any traces in the future. This type of interaction involves only superficial *actors bonds* (Håkansson & Snehota, 1995: 192-99)

- *Cooperation* (“sam-verkan”): entails a joint communicative and intellectual activity of short-term character organized around a possibly common goal. In this type of interaction, next to stronger actor bonds also some *activity links*, although superficial ones, appear (Ibid: 50-6)
- *Collaboration* (“sam-arbete”): entails joint work of both communicative/intellectual and practical character oriented towards a commonly agreed goal, conducted within a short timeframe, but with tangible outcomes that can create a bridge for long-term interactions between university and researchers. In this type of interaction, all three layers of the ARA-model, including *resource ties* (Ibid: 132-8), appear, even if within a time constrained interaction episode such as a research project.
- *Relationship*: emerges when several interaction episodes, such as the three types above, are repeated over a longer period of time. But in order to become a *deep* relationship also *adaptations* (Håkansson, 1982: 19) between the parties are necessary.

5.2 The process of crafting university-industry interactions at Uppsala University

We can now turn to our second research question, namely how does a university craft these types of interactions? The cases of AIMday and SMURF illustrate somewhat different approaches to the process of crafting university-industry interactions. AIMday is a tool aimed primarily at creating rewarding meetings in terms of *cooperation*, whereas SMURF is a tool providing funds for establishing *collaborations* between researchers and businesses. However, taking a broader perspective on the overall process of crafting university-industry interactions, a common starting point for both interaction-stimulating tools, and for Uppsala University’s overall strategy, are superficial interactions which the university management aim to transform into deeper, long-term relationships between academic researchers and industry. Moreover, the university management aims to create such relationships not only between the two parties, companies and researchers, but also between companies and the university management itself, in the form of such interaction enablers as its UUI and ÅMA unit. Illustrated below is how the process of crafting interaction works, relying on the interaction typology described above. We also highlight how this process can take on different routes in the hope of creating long-term and deep relationships between academia and industry.

Even though there are researchers and companies that do have long-term relationships with each other, the following analysis focuses on Uppsala University management’s efforts of crafting *new* interactions of this type. UUI is a key enabling actor that operates such tools and platforms as ÅMA, AIMday and SMURF as attempts to initiate interactions between researchers and companies and steer them towards becoming deeper and long-term relationships.

5.2.1 Fostering participation: showing value and creating interest

The interaction-enabling actors are very important especially when it comes to creating the superficial type of interaction that we termed *participation*. They have the specific task of *contacting* and *showing* to researchers and industry the relevance of *meeting* each other, thereby enabling the creation of participation. AIMday and SMURF are fundamental here because they materialize and substantiate several values of participating in university-industry interactions: in fact, these two innovation-stimulating tools make it possible for the university management to illustrate benefits for both parties, such as deepening one's understanding of a problem, but also obtaining additional funding for own research or even starting a collaboration project. The two interaction-stimulating tools focus on industrial problems, a strong argument for *creating interest* and *attracting* companies which are traditionally hesitant to spend resources on interactions if these do not give them something concrete in return. In other words, by marketing the very AIMday and SMURF concepts and informing both researchers and companies about the advantages of interacting, UUI manages to craft a will to participate from both sides.

By using these two tools as a way to relate to both researchers and industry, UUI also constantly creates *new contacts*, which act as starting point for possibly deeper types of interaction, which UUI can further stimulate. When deeper interactions between researchers and companies happen through UUIs' tools and platforms, the university management also gains more knowledge about the specific counterparts, their needs and agendas, which makes it easier to directly connect them to each other on a deeper level of interaction than participation. ÅMA, with its members and joint university-industry board, shows how this can happen.

5.2.2 Fostering cooperation: promoting exchanges

When researchers and companies engage themselves to the level of being present together (i.e., participating), the next step for UUI is to stimulate a deeper form of university-industry interaction whereby the two parties start exchanging something valuable, typically knowledge. The interaction-enabling actor UUI stimulates such an exchange via AIMday by strictly orienting the discussions towards industrial problems and then identifying researchers for whom those very same problem are interesting, so that they are not simply willing to "participate" (the previous level of interaction), but also to "contribute" something to the discussions which is hopefully valuable to the industrial party. Even though SMURF seems to aim directly to the creation of an even deeper form of interaction, namely collaboration, it still does not get there immediately, but the collaborations it fosters are preceded by some form of cooperation, namely when a researcher and a company engage in a rewarding exchange while they attempt to formulate a project plan hoping to receive funding. Just as the discussions occurring during the meetings on AIMday, the joint writing of a project application is a way for UUI to more actively steer and push researchers and companies to match each other, and ensures that both parties will benefit.

5.2.3 Fostering collaboration and something more?

As described above, collaboration is a deeper type of interaction than cooperation as it also entails the exchange or even sharing of several resources, including physical and financial ones. This also means that collaboration is more concrete and measurable, when it comes to the utilization of science, than both participation and cooperation. Thus, the creation of collaborations is very important for interaction enablers such as UUI and its ÅMA unit. However, looking at AIMday, this is where the organisers start to lose control, because the step from discussions (cooperation) to the creation of collaboration between the same researcher and the same company is difficult to steer. There seems to be here, at the boundary between "cooperation" and "collaboration", other values, such a broader contact network or better technical understanding, that may make the two parties fully satisfied and uninterested to proceed further. However, by connecting AIMday and SMURF, UUI hopes to increase its control over the creation of collaborations: in fact, offering funding during an AIMday increases the interest of moving from cooperation to collaboration, especially for academic researchers, which also increases the number of promising collaboration applications coming to SMURF.

Therefore, UUI explicitly applies a set of specific incentives aiming to influence the very nature and depth of interaction between a researcher and a company, making implicitly this interaction part of a sequence of interactions that, in the hopes of the interaction enablers, might prolong in the future. And when interactions have both a history and a future, we would face a potential relationship (Håkansson & Snehota, 1995). However, in such a relationship, the university management units (e.g., UUI) remain a third-party in relation to the dyad "researcher-company" (see figure 1, 2 and 3), thereby further reducing their possibility to influence the dynamics of this interaction (Salo, Tähtinen & Ulkuniemi, 2009).

In fact, if the creation of collaborations is difficult to control, the creation of real relationships is even harder to control (Håkansson & Ford, 2002), including its quantification and measurement. As described above, for real relationships to develop, several interaction episodes need to follow each other across time and the deeper these interaction episodes are, such as a collaboration, the bigger the probability is that they will lead to a relationship. However, there is no guarantee that deeper interactions will lead to even deeper ones, as the development of inter-organizational interactions and relationships can always revert to a previous interaction stage (Ford, 1980; Ford et al., 2003: 51-8). UUI's current interaction-enabling tools may not provide the possibility of surgically intervening in a specific researcher-company interaction with ad hoc solutions to boost it, but they do create a regular basis for interactions which simply increases the chances for some interactions to take the direction of becoming relationships. Moreover, UUI and especially its AIMday tool constantly generate what may be viewed as the weakest form of interaction (which therefore was not included in our four types), namely *contacts* (i.e., acquaintances) between academic researchers and industry. Contacts are indeed "potential interactions", which may be activated or not in the future, but which in the present result into a *broader network of new contacts* or *deeper existing contacts*. These contacts are viewed as highly valuable by both researchers and companies, simply thanks to their potential to lead to the creation of both collaborations and relationships if needed in the future. The connections between the various types of interactions crafted by Uppsala University management are shown in figure 4 below.

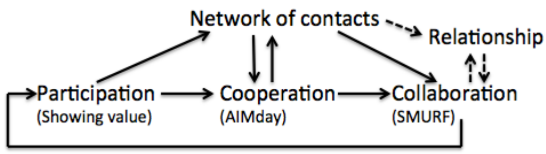

Figure 4: A model over the crafting of university-industry interactions

The model should not be taken as linear and deterministic, because two interacting parties can always exit from the sequence and maybe delimit themselves in the future to simple "participation" instead of moving towards a relationship, which remains a hard won trophy in this context. Moreover, the instruments applied by the interaction-enabling units do have their limitations making the strength of the arrows in the model even weaker: for instance, AIMday seems to be a tool more apt to create cooperation than collaboration, while UUI's tool specifically addressing collaborations, that is, SMURF, can only finance collaborations between researchers and companies that have had *no previous deep interaction*. SMURF cannot either finance the next development steps following a concluded collaboration, those that could lead to more joint activities and deeper resource combinations and even a long-term relationship. Quite interestingly, SMURF does include explicitly a relationship building phase (somewhat incorrectly termed "networking" in the official documents), but this phase is conducted by that platform only as a match-making and consulting activity, with no direct financial resources to boost long-term relationships. The rationale seems to be here that if the parties really value their collaboration and intend to continue for the longer-term, they should be able to either finance it themselves or make the effort to find third-party financing, for which SMURF can provide only consultation.

5.3 Perceptions and measurements of interactions by the involved actors

We now turn to our third research question, that is, how the involved actors perceive, assess and measure the interactions resulting from AIMday and SMURF. This analysis will also help us address our fourth research question, namely which differences exist between these perceptions and assessments.

Starting from the interactions related to AIMday, researchers perceive a set of effects and values included in the *cooperation* type of interaction: mutual knowledge exchange, learning from the "real world" of industrial companies as a way to adjust their research agenda to fit industrial needs and obtain additional funding for it (even if these effects do not happen during an AIMday, but take certainly some time to emerge), and marketing their equipment. Researchers view also *contacts* as another important type of interactions (or "potential interaction", see above) that can result from an AIMday. As for companies, their perceptions of AIMday partly match and complement, from the other side of the interaction type *cooperation*, those of researchers: for instance, also companies evaluate positively the knowledge exchange (insights in new literature, better understanding of problems), promoted by AIMday's discussions, as well as the purchasing channel opened for the researchers' equipment. Similarly to researchers, also companies view AIMday as a tool generating new *contacts* to broaden and deepen their network. However, a difference from researchers is that companies consider AIMday as a fruitful tool also to strengthen their already *existing relationships* with specific researchers. Probably, companies view the AIMday cooperative discussions as additional episodes in the stream of interactions that binds them with selected researchers. Finally, both companies and researchers downplay instead the role of AIMday in creating *collaborations*, as these does not seem to be the value they search for or experience during the interactions initiated by this platform.

Against this background stand instead a long list of performance indicators that UU Innovation has informally started to apply for evaluating AIMday. Table 1 below presents these performance indicators and relates them to the values and effects that they aim to evaluate. KPIs from 1 to 6 indicate direct and easily quantifiable effects of an AIMday, deriving from the simple fact of organizing such an event, while KIPs from 7 to 10 indicate more indirect and softer effects that relate more with the values pointed also by both companies and researchers (i.e., *contacts* and *cooperation*). KPIs 11 and 12 address instead *concrete collaborations* and the related outputs, which were not however identified as relevant values of AIMday by either companies or researchers.

	KPI	**Value measured**
1	Number of AIMdays	The support organisation's general facilitation of university-industry interactions
2	Number of questions submitted	Industry's interest of meeting with academic research
3	Number of participating companies	Perceived value of meeting with academic research
4	Number of participating researchers	Perceived value of meeting with industry
5	Number of participating research divisions	Utilization of multidisciplinary research
6	Number of participating universities	Growing interest in AIMday
7	Number of participants that created new contacts	Potential interactions usable for future deeper interactions
8	Number of participants that developed new knowledge about the topic(s) discussed	Utilization of academic knowledge (cooperation)
9	Number of participants that felt that the discussion where of relevance for their future work	A further utilization of academic knowledge (cooperation)
10	Participants' overall impression of the conference: and willingness to attend again	Perceived value of AIMday and its interactions
11	Number of SMURF-funded applications for pre-studies to collaboration projects	Perceived value of collaborating and of funding projects via SMURF
12	Number of collaborations initiated via AIMday	Concrete outputs

Table 1: Emerging indicators applied to AIMday

As for SMURF, similarly with AIMday researchers stress the importance of exchanging knowledge with industry, indicating a form of *cooperation*, and creating *contacts* (mostly for educational purposes). However, an important difference between SMURF and AIMday-stimulated interactions, is that researchers prefer the former's ability to create *concrete returns* (including financial ones) within steered and well defined, indeed time-constrained, *collaborations*, if compared to loose and open-ended discussions with industry (i.e., a general type of cooperation). Interestingly, researchers do consider these SMURF-based collaborations as conducive to long-lasting and deep *relationships*. The companies' perceptions of these interactions only partly match those of researchers: companies too appreciate the new perspectives deriving from *cooperation* with researchers, but especially the *concrete results* as well as lab access obtained via these *collaborations*. Companies view SMURF-interactions also as a way to create deeper connections to be used for future collaborations, which we can interpret as *relationships* of *low intensity* (Håkansson & Snehota, 1995: 344; 370-1). But an important difference between companies' and researchers' perspectives is that the small companies involved in SMURF appreciate the *contacts* with researchers more as a way to improve their *reputation* in relation to third parties in their network (**Anderson,** Håkansson & Johanson, 1994: 4; Håkansson & Snehota, 1995: 32), rather than only as a ground for developing the dyadic relationship (Ibid) with that same researcher. Finally, no companies are able to evaluate such long-term effects as new employments derived from SMURF collaborations.

Against this background, UU Innovation evaluates formally the interactions stimulated by SMURF on the basis of the key performance indicators presented in Table 2. These indicators capture mostly the *cooperation* and *collaboration* types of SMURF-initiated interactions, including also some concrete and long-term outputs such as *patents* and *publications*. In this sense the KPIs applied by UUI correspond by and large to the values stressed by researchers and companies. As for long-term *relationships*, mentioned as important by researchers and by companies, there is only one KPI (nr 6) that measures them, but it simply counts their number without penetrating into their features. This lack of explicit and detailed indicators for business relationships does not mean, however, that UUI is not concerned about long-term relationships: the problem is instead one of control, as UUI reckons that the development of business relationships is outside their control and depends on the choices of companies and researchers. It becomes accordingly more feasible for UUI to provide a tool that permits the first contact, some form of cooperation and a somewhat deeper interaction, although a time-restricted one, via a concrete collaboration.

	KPI	Value measured
1	Number of SMEs met for information purposes	The value of reaching out to the business community
2	Number of participants in various events (companies and researchers)	Industry's interest in meeting academic research. Understanding interests and needs within industry
3	Number of fruitful meetings between SMEs and academic researchers	Utilization of academic knowledge
4	Number of projects initiated	Utilization of knowledge via collaborations leading to concrete outputs
5	Number of patents/scientific articles jointly created by an academic researcher and SME employees	Concrete as well and long-tem outputs from the collaboration
6	Number of companies involved in "networking" activities as a result of participating in SMURF	Count of long-term relationships
7	Number of employment opportunities created	Long-term effects for regional economic growth

Table 2: Key performance indicators applied to SMURF

Bringing together our observations on how companies, researchers and UU Innovation evaluate both AIMday and SMURF-initiated interactions, a *first finding* is that, by and large, companies and researchers have convergent or matching views on these interactions. In fact, both researchers and companies value positively the opportunity provided by AIMday to create *contacts* (cf. "networking for networking's sake") and to *interact cooperatively*, while downplaying its role in fostering *collaborations*, which they both view instead as a major value of SMURF. Both researchers and companies also stress the importance of *concrete collaborations* with a restricted timeframe and direct outputs. But here is where the perspectives of companies and researchers start to diverge, which is our *second finding*: while researchers value collaborations with industry for their direct, short-term returns (including financial ones), companies value collaborations (but also cooperation) not only for these direct effects, but also as means for *building long-term relationships* or even to be used in relation to *third parties* in the network for *reputational* purposes. Even though this finding needs to be further validated, it seems to point to the fact that companies utilize all types of interactions with researchers more "strategically", that is, by relating them to the larger context and the long-run strategy of their business.

If we compare these views of companies and researchers with the KPIs applied by UU Innovation, formally (in the SMURF case) or informally (in the AIMday case), our *third finding* is that most KPIs focus either on *superficial* forms of interaction (contacts, participations and cooperation) or on *deeper* although *time-constrained* interactions (one-shot collaborations), while neglecting *long-term deeper* interactions, namely full-blown *relationships*, which were instead considered as valuable by both companies and researchers. In fact, while the applied KPIs focus mostly on such types of interaction as contacts, cooperation and collaborations, which companies and researches certainly appreciate (even though for different purposes, as discussed above), there is only one indicator (nr 6 in Table 2) which focuses on long-term relationships, despite the value that all three parties actually attribute to them. In fact, not only companies and researchers view relationships as valuable, but also UU Innovation does so, as witnessed also by the alliance platform ÅMA. However, in the case of ÅMA, UU Innovation are themselves directly involved as party to this long-term relationship and therefore implicitly apply to it KPIs that correspond more to the expectations and assessment that companies and researchers would make of a long-term deep relationship.

6 Conclusions

This paper has contributed firstly a *typology* of university-industry interactions including four main types, namely "participation", "cooperation", "collaboration", and "relationships", to which a fifth "potential interaction" type can be added, namely "contacts". This typology is based on such dimensions as depth, type of exchange, involved resources, intensity and duration. These five interactions can also be analyzed by means of only two dimensions: *depth* and *duration*, as shown in figure 5 below. While "participation" is both short term and superficial, its opposite is "relationship", which is both long-term and deep. "Collaboration" is instead deep, but short-term, while "contacts" are long-term although superficial interactions. Finally, "cooperation" is somehow in the middle when it comes to depth and duration: while its depth is contained between the extreme of participation and collaboration, the duration of cooperation can vary considerably between short-term and long-term cooperation.

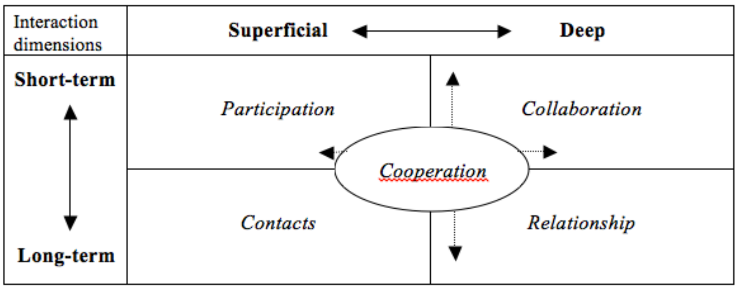

Figure 5: Five interactions type in terms of depth and duration

The second contribution of our paper is a model showing how a university's management works in order to craft these five types of interactions towards the hoped-for for result of creating *long-term relationships* with industry. In this sense, it appears that a relationship requires the presence of all other four types from which it eventually emerges, but crafting all of them is no guarantee to obtaining a real, long-term relationship. In fact, university management is at best one of three parties in such relationships, which makes them even more difficult to control than "simple" dyadic relationships, or even worse university management may be only a third party in relation to researchers and companies.

Finally, our results indicate that whereas the official KPIs applied by the university focus either on abstract or on short-term & concrete interactions (i.e., participation, contacts, cooperation and collaborations), companies pay less attention to short-term results from collaborations with researchers and more to the future development of a deep relationship with researchers. For companies, concrete short-term interactions and results are not a goal per se, but a tangible means for building a long-term relationship.

Our findings also suggest avenues for further research: Firstly, our typology and the process model on crafting interactions needs to be validate by analyzing other cases from other universities. In particular, the “relationship” type of interaction deserves to be investigated more closely, as well as the connections between the other types of interactions and relationships. Secondly, further research is necessary also on the *reasons for* the differences in the perceptions and assessments of interactions made by companies, researchers and university management.

This paper also suggests policy implications for agencies and university units engaged in the diffusion of science to society or in stimulating economic growth based on academic research. Applying Uppsala University’s “proactive” approach based on building relationships, or at least collaborations, with industry should not be seen as a simpler alternative to playing the “market game” which is necessary for commercializing patented discoveries. While the “market game” is difficult and risky because no licensors, customers or financiers might be found for a scientific discovery, the relationship-building approach faces the difficulties implicit in creating relationships. It is relatively easy to create contacts, participation and even cooperation between researchers and companies, but things become more complicated when the goal is crafting actual collaborations.

And finally relationships are very hard both to create and control, especially by a third party, which often university management is in such constellations. Still, the ÅMA experience briefly touched upon in our empirical material show how this can work: university management takes a very active role in “handling” this multi-party relationship, which in turn relies on previous cooperation and collaboration episodes between single researchers and companies. However, the resources the university management had to invest in order to build, develop and handle such a relationship are considerable, with at least one project manager acting as a sort of dedicated Key Account Manager. This suggests that such highly focused efforts can be motivated only for interactions/relationships that can become potentially very large, for instance with very large corporations or with a restricted pool of similar companies that can be held together within an alliance revolving around a common theme (e.g., within a specific sector or technological area). Most of the interaction-stimulating efforts reviewed in this paper, especially those supported by EU or national agencies’ funds, imply instead blanket-like interventions that aim to capture as many companies as possible in a generalized way, according to the idea that the more companies participate or create contacts or cooperate, the better it is. Probably, “the law of the large numbers” plays some role in finding adequate interaction partners for superficial interactions, some of which might then turn into long-term relationships, but what is really needed for getting there is more focused efforts and resources to be allocated to single relationships rather than to the whole population of potential relationships.

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Developing Agrifood Clusters In The Netherlands: Insights From Practice Revealed

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Abstract
Due to increasing competition from a globalising market, new consumer preferences and demand for more sustainable production, innovation is needed in Dutch agrifood clusters. In addition, government has recently launched new policy to enhance the competitiveness in agrifood clusters through a better cooperation between businesses, science and education. The developments mentioned result in a need for effective innovation strategies and practices among stakeholders. In this paper we discuss the outcomes of an exploratory study among six agrifood clusters in The Netherlands. Main subject of research are the cluster organisations, their differences and their effects on cluster impact. The insights of this paper are based on extensive consulting experience in facilitating agrifood clusters in The Netherlands. The study raises questions for reflection in practice and a conceptual framework is developed for further research.

Keywords
Cluster, innovation, SME, cluster organisation, fit, impact

1 Introduction

The importance of clustering for innovation and economic development has been described by many authors. Porter (1998) argues that clusters affect competition in three ways: (1) by increasing productivity of companies based in the area, (2) by driving the direction and pace of innovation and (3) by stimulating the formation of new businesses. Based on a number of international success stories, such as Silicon Valley, clustering has been an important part of economic policy in recent years. In The Netherlands, a number of agrifood clusters have been identified as important 'ecosystems' for valorisation, innovation and economic development. Based on this policy many different stakeholders are making an effort to contribute to the success of these clusters, creating cluster organisations and implementing various agendas, projects and activities. But how to effectively govern an agrifood cluster? Great differences in cluster governance and cluster facilitation can be distinguished, both from theory and practice. These varieties are partly explained by the variety in clusters. But the characteristics of a cluster organisation are also influenced by internal factors in the cluster organisation (e.g. human factors and organisational factors). How these cluster organisations are formed and what factors influence the character and subsequently the impact of these organisations is still a knowledge gap in cluster literature. Based on both literature and findings from practice we (1) describe the variety in cluster organisations, (2) identify factors that determine the variation in cluster organisations and (3) reflect on the relation between characteristics and success of cluster organisations. Based on this study a conceptual framework is developed which can be empirically tested in further research. Furthermore an implicit part of policy implementation will become more explicit. By gaining insight in the determinants of certain characteristics we enable practitioners to become aware of hidden dynamics and become more effective in cluster governance and facilitation.

2 Literature

A cluster is a geographic concentration of interconnected companies and institutions in a particular field (Porter 1990, 1998). Typical for a cluster are its sectoral specifity and high density of interactions between members (Asheim and Coenen, 2004). In this research, the cluster organisation takes a central position. Cluster organisations are set up in order to increase effectiveness of the cluster. Innovation activities governed by cluster organisations are often pursued to initiate innovation, or enhance innovation capabilities in the cluster (Batterink et al, 2010). There are various mechanisms that contribute to the impact of clusters, such as knowledge spill-overs and learning. Studying the specific mechanisms behind cluster impact is outside the scope of this exploratory research.

2.1 Cluster organisation

A cluster organisation can be described as a collaboration of stakeholders that govern innovation initiatives targeted at the network of companies in the cluster (Batterink et al., 2010). In general the cluster organisation is involved with network management in the cluster (Kickert et al., 1997). Their role can for example be a network broker or network orchestrator or both. In other words they can have a role in the design and management of the network (Batterink et al., 2010). This role can be fulfilled by for example large and dominant firms in the network. Small and medium enterprises generally do not have the capacity to fulfill this role. Batterink et al. (2010) describe the growing presence of systemic brokers: professional organisations specifically concerned with the role of network broker or orchestrator. Initiative for network management or setting up a cluster organisation can be taken by any stakeholder. Cluster organisations can be described using dimensions, namely the key characteristics and the development of ‘fit’. Both dimensions are further explored below.

2.1.1 Key characteristics

Earlier case study research on agrifood clusters in The Netherlands has provided some elementary insights into the key characteristics of the cluster organisation (e.g. Wubben et al., 2011). Three components are considered to be critical: strategy, activities and organisation. First, the *strategy* of a cluster organisation describes the competitive position of a cluster and the ambitions towards the future. Often, cluster organisations clarify the strategy by formulating guiding themes for the cluster itself – with regard to innovation, valorisation and/or competitiveness. Depending on the external and internal environment of a cluster organisation, a certain strategy might suit a cluster better than another strategy. As a consequence, cluster organisations in The Netherlands pursue different strategies and they can be differentiated accordingly. Second, it is possible to characterise the cluster organisation through its *activities*. The activities of a cluster organisation generally follow the strategy of a cluster. For example, a cluster organisation with a focus on enhancing the technological level of players in the cluster might stimulate the valorisation of knowledge and investment in R&D. A cluster organisation with a focus on product and market innovation could for example improve innovation performance through the involvement of related and supporting industries – e.g. in workshops or matchmaking events. Third, the *organisational* component characterises the cluster organisation and includes aspects such as structure, stakeholder composition and finances. The organisational component is not only influenced through choices made on strategy and activities, but it is also shaped by the external and internal forces. The different context of each agrifood cluster leads to a specific outcome and therefore a diversity in cluster organisations.

2.1.2 Fit

Cluster organisations are always collaborations between different stakeholders. Douma et al. (2000) emphasise the importance that, in collaborations, partners should not only focus on individual benefits but also continuously searching for a good fit. The concept of fit refers to the degree to which the partners in the cluster organisation are aligned. Can the cluster organisation be described as a coalition with mutual benefits, harmony and dependency among stakeholders? Whether or not fit exists in the cluster organisation, depends on both interaction with the external environment and internally. With regard to the external environment, fit is influenced by the compatibility of strategies among players in collaboration. Indicators in this regard are: incentives among partners, shared vision, complementary goals and stakeholder acceptance (Douma et al., 2000; Park et al., 2001). The internal fit concerns the more intangible aspects – e.g. the culture and personal relationships.

2.2 Determinants: external and internal factors

This section explores the factors that determine the variation in cluster organisations by studying current literature. As with the strategy and organisation of any other organisation, cluster organisations are influenced by factors from the external and internal environment (e.g. Ireland et al., 2009). The various levels in the external and internal environment are illustrated in figure 1.

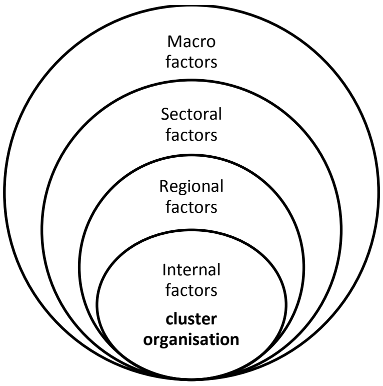

Fig. 1: External and internal environment of cluster organisations

2.3 External factors

The external environment of a cluster organisation is very diverse and includes all factors that in theory could influence the organisation. Some factors are within the sphere of influence of the cluster organisation, while other factors are outside the zone of control. To distinguish between these factors, three 'levels' in the external environment are distinguished: the macro level, the sectoral level and the level of the region (McGee et al., 2005).

2.3.1 Macro factors

Cluster organisations are shaped and influenced by factors coming from the general environment of a cluster. Although these factors are often outside the zone of control of the cluster organisation, they can significantly alter the strategy and structure. A common tool to assess the sensitivity for factors on this macro-level is a PEST-analysis – applied to analyse political, economic, social and technological factors (McGee et al., 2005). The *political factor* can represent a serious influence on the cluster organisation. Over the last couple of years for example, both regional and central governments are stimulating the development of regional clusters in the food and agricultural domain (Batterink et al., 2010). In addition, public policy can also influence the strategy or direction of existing cluster organisations. Finally, the legislation that is produced by policy makers, for example competition and food laws could affect the strategy of a cluster organisation. Also the *economic factor* influences the strategy and activities or a cluster organisation. Changes in firm investment, consumer spending and business cycles can lead to a different focus of cluster goals and activities. The *social environment* presents a similar influence on cluster organisations. Changes in values and culture, for example the appreciation of sustainable food and agribusiness, can lead to the development of firm collaborations and networks. The final factor of the PEST-framework, *technology*, is also a potential source of cluster development and change. Developing new technologies and participating in cutting edge research initiatives, for example in the field of biotechnology, is for many firms only possible by collaboration and knowledge sharing.

2.3.2 Sectoral factors

Factors on the sectoral level often more directly influence the strategy and organisation of cluster management. Porter's 'Diamond' offers a useful framework of factors on the sectoral level (Ireland et al., 2009). Four types of factors are distinguished: factor conditions, related and supporting industries, demand conditions and firm strategy, structure and rivalry. First element in the framework is the *factors of production*, which refers to availability of inputs necessary for production. Two types of production factors are differentiated: basic factors and advanced factors. Basic factors refer to conditions such as natural resources, labor and land, while advanced factors refer to the presence of e.g. a strong research or knowledge system. Both basic and advanced factors can influence the cluster organisation, as it develops a strategy to maximise competitiveness. The buyers' nature and needs characterise the *demand conditions* in the environment of a cluster organisation. Whether businesses in a cluster serve a domestic market or an international market, shape the activities of a cluster organisation. The third element in the framework is the presence of *related and supporting industries*. Well established suppliers and service-providers can lead to a highly competitive sector. Cluster organisations will therefore include the strength of supporting industries in their cluster strategies and activities. Finally, *firm strategy, structure and rivalry* can influence cluster organisations. For example, a region containing a high degree of SME's – that are related in business – have an incentive to cooperate for innovation, as the individual resources are limited. These characteristics on the sectoral level will influence the strategy and activities of a cluster organisation.

2.3.3 Regional factors

In addition to the macro and the sectoral level factors, which are described for organisations in general, there are some factors specific to clusters; the so-called regional factors. The identity of a cluster can be defined by many characteristics. From Porter (1998) the following can be distinguished:

› Size of the cluster (number of firms)

› Particular field (technology, subsector, etc.)

› Variety of linked firms and organisations (for example whole supply chain, complementary products and service providers)

› Presence of specialised knowledge or inputs

- Inclusion of demand side and customers, presence of sophisticated buyers
- Involvement of government insititutions
- Involvement of research institutions
- Involvement of educational institutions

Additionally Asheim and Coenen (2004) distinguish between two knowledge bases of firms and industries: ’analytical’ and ’synthetic’. An analytical knowledge base refers to industrial settings, where scientific knowledge is highly important. Strong university-industry links are more frequent in clusters with an analytical knowledge base. A synthetic knowledge base refers to industrial settings where innovation often takes place through the application of existing knowledge or through new combinations of knowledge. In case of an analytical knowledge base ties between the regional innovation system and the cluster tend to be stronger. Boari (2001) adds the importance of presence of focal firms to the emergence, growth and performance of the cluster. Focal firms are often larger and faster growing firms that play roles of for instance: sophisticated buyers, incubators for future entrepreneurs, supporters of start-ups and agents of change.

2.4 Internal factors

In literature, several internal factors that influence the internal dynamics of cluster organisations are identified: resources, capabilities, stakeholders, trust, culture and personal relationships (Ireland et al., 2002).

2.4.1 Resources

A unique bundling of several resources has the potential to lead to a competitive advantage (Ireland et al., 2009). The resources of a cluster organisation can be divided between tangible and intangible resources. Tangible resources are assets that are visible and can be quantified (Barney, 1991). Examples of tangible resources owned by cluster organisations are: financial resources (e.g. internal funds) and physical resources (e.g. office building, innovation demonstration center). Intangible resources, on the other hand, are invisible and are accumulated over time (Hall, 1992). Examples of intangible resources in possession of cluster organisations are: human resources (e.g. knowledge, network), innovation resources (ideas, skills to stimulate innovation) and reputational resources (e.g. legitimation by stakeholders).

2.4.2 Capabilities

When resources are combined and integrated in a unique way, capabilities arise within organisations (Dutta et al., 2005). Baser and Morgan (2008) distinguish five different types of capabilities relevant to cluster organisations: (1) to commit and engage, (2) carry out technical, service delivery and logistical tasks, (3) to relate and to attract resources and support, (4) to adapt and self-renew and (5) to balance diversity and coherence. A combination of these capabilities could lead to an effective cluster organisation – capable to reach its goals.

2.4.3 Stakeholders

Most cluster organisations that pursue innovation have several participants involved in the formulation and execution of the cluster strategy. Participants with high stakes and power positions, and who in this context are part of the cluster organisation, are called stakeholders (Wubben et al., 2011). Examples of stakeholders in agrifood clusters are: businesses, business organisations, governments, knowledge institutes and educational organisations. The collection of stakeholders in a cluster organisation can lead to different strategies or activities, as each stakeholder pursues certain goals and incentives.

2.4.4 Trust

When stakeholders in a cluster organisation can depend on each other to reach a common goal, trust exists (Ireland et al., 2002). The three critical components of trust are: predictability, dependability and faith. Trust between stakeholders does not only lead to a reduction of monitoring costs, but also leads to better collaboration.

2.4.5 Culture

Research shows that failure of collaborations is often caused by cultural distance, leading to disagreement about objectives and poor communication (Stanek, 2004). Collaborations such as cluster organisations often consist of participants from different backgrounds. A person with a government background often applies different language and concepts than somebody with a business background.

2.4.6 Personal relationships

Although highly related to some of the factors discussed earlier – such as stakeholders, trust and culture – personal relationships are often overlooked as a critical factor in the success of collaboration (Stanek, 2004). Positive personal relationships between stakeholders however, can greatly contribute to the effectiveness of a cluster organisation, as it leads to higher levels of trust and commitment. The other way round, poor personal relationships between stakeholders in the cluster organisation can lead to poor execution of activities and failure to meet objectives.

2.5 Effect on cluster impact

Wren (2007) distinguishes fives levels to establish the effect of cluster organisations on regional clusters: input, process, output, outcome and impact level. *Input* refers to the resources or activities used for the intervention by the cluster organisation, e.g. costs of human resources and marketing. *Process* involves the interventions by the cluster organisation, e.g. the number of workshops organised or the number of vouchers available to entrepreneurs. Success on *output* level can be measured by looking at the result of the process stage. For example: how many entrepreneurs participated in the event organised by the cluster organisation and how many requested an innovation voucher? The fourth level of measuring success involves the *outcome* of the intervention – e.g. did entrepreneurs actually use the voucher to invest in R&D or a market research? The final level refers to the original goal of the intervention: the *impact* level. According to Porter (1998) cluster impact can be defined as follows: (1) increased productivity of companies based in the area, (2) direction and pace of innovation, and (3) formation of new businesses. Other growth indicators that are commonly used to define cluster impact are: increased exports, employment and production (Provincie Noord-Holland, 2007). For the evaluation of the effectiveness of a cluster organisation, it is important to develop indicators and monitor progress on all five levels of success. Most evaluations however, only include information on the input, process and output level (Van der Vlist et al., 2007).

2.6 Conceptual framework

Based on studied literature a conceptual framework is developed for further analysis (see figure 2). The conceptual framework illustrates the relations between determinants (internal and external factors), cluster organisation (key characteristics and fit), and the effect on cluster impact.

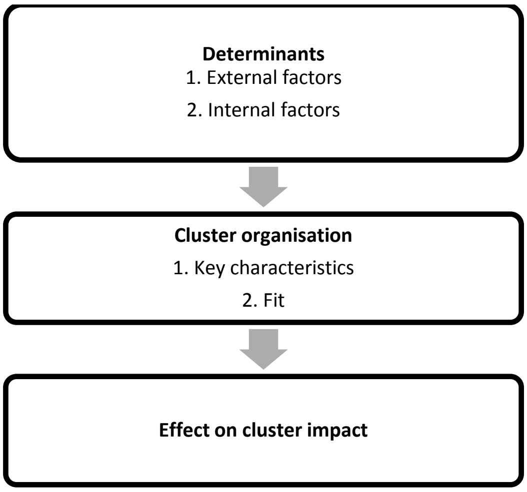

Fig. 2: Conceptual framework

3 Research approach

This paper is based on the following (exploratory) research questions:

(1) What are differences between clusters and their cluster organisations?

(2) What are the factors that determine these differences?

(3) What effect on cluster impact can be identified?

Six regional agrifood cluster organisations were selected as research subjects. To answer the research questions several methods of data collection were combined, in order to triangulate the findings. *First*, a literature study was performed to develop a conceptual framework. *Second*, through desk research (websites and policy documents), information on the six cluster organisations was collected. *Third*, Syntens consultants engaged in cluster facilitation and regional account managers were interviewed in semi-structured interviews. Eleven interviews were conducted, of which ten face-to-face and one by telephone. For each cluster two respondents were interviewed, except Greenport Zuid-Holland, for which only one person participated. *Fourth*, the data from the interviews were validated and enriched in a workshop in which consultants and account managers that were interviewed participated. Additional participants were the project manager and project assistant of agrifood projects, and the manager business intelligence who had just finished a study on clustering (all Syntens staff). *Fifth*, an exploratory study was performed by research and consultancy company Motivaction (executed upon request by Syntens). Various cluster stakeholders were interviewed on typical characteristics and performance of the cluster organisations. The Motivaction study includes three clusters: Innexus, Greenport Zuid-Holland and Food Connection Point. Twenty persons were interviewed: two respondents from the Ministry of Economic Affairs, and eighteen from various organisations involved in the three clusters: entrepreneurs, research institutions, educational institutes, regional development organisations and project organisations. Nine interviews were conducted face-to-face and eleven by telephone.

4 Findings

This paragraph presents the findings of the six agrifood cluster organisations studied. As the macro level factors are similar for the six organisations, the paragraph is split in two sections: a general section on macro factors and a section on the individual cluster organisations.

4.1 Macro factors

Government policy has significantly influenced the agrifood cluster organisations in the Netherlands in the last couple of years. One major contibutor was the introduction of a new industrial policy, in which agrifood and horticulture were identified as ’topsectors’ for the Dutch economy. This recognition paved the way for additional attention and (financial) support for the regional cluster organisations. The rationale behind this policy is that governments expect economic benefits through the development of clusters, such as an increase of production, innovation or employment (Wubben et al., 2011). In order to materialise these benefits, governments provide cluster organisations with financial resources or flexibility in legislation. These public policies have led to an increase in the founding of cluster organisations in The Netherlands. Economic conditions on the other hand, created a difficult environment for investing in innovation. The current economic crisis at the same time forces both private and public organisations to develop strategies to remain competitive and economically viable. Cooperating in a cluster is one of the options to achieve these goals. Trends in society and technology continued steadily, towards a more advanced and sustainable agrifood sector.

4.2 Greenport Venlo Innovation Center (GVIC)

4.2.1 External factors

GVIC is a cluster organisation situated in the Venlo-region in the south-east of the Netherlands. The agrifood cluster that is served involves horticulture, agriculture and important supporting industries like logistics, packaging and machinery. The location near important European markets like Germany, Belgium and France make Greenport Venlo an important (logistical) hub for horticulture exports to these countries. Apart from horticulture and agriculture, logistics and various industrial sectors are considered part of the cluster. There is a number of leading firms in the area, for example Scelta, Laarakker and Freshpark. There is involvement of government and educational institutions. R&D activities in the agrifood firms is limited. This can be illustrated by a quote of the director of Greenport Venlo Innovation Center: *"small and medium enterprise in agriculture often do not have the time to develop their ideas"*.

4.2.2 Internal factors

Like all Greenports, initiative for the cluster organisation has been taken by government. The cluster organisation has financial, physical and human resources to govern and support the cluster. Financial resources are mainly project based external funds. The cluster organisation is said to be very capable with a highly motivated and committed director, a smart use of existing structures, good access to funding and resources, an ability to show short term results and commit entrepreneurs to the program. There is a large range of stakeholders directly involved in the cluster organisation. Noticeable for a Greenport is the presence of entrepreneurs in the board of the Greenport Innovation Center. Research institutions are not involved in the organisation.

4.2.3 Key characteristics

Strategic focus of GVIC is in broad economic goals, assuming that investment in the region leads to a multiplier effect and further economic development. The organisation is mainly a project organisation, depending on current projects and funding. Main activities are project development, matchmaking, challenging and investment subsidies.

4.2.4 Fit

In the Greenport Venlo Board Province, region and business organisations take part, while the GVIC board consists of entrepreneurs from the cluster. There is a good external and internal fit in the cluster organisation. There seem to be sufficient interests to cooperate, conguence in objectives and complementary resources and strategies. The levels of influence and trust in both gremia are balanced.

4.2.5 Effect on cluster impact

The impact of the recent Floriade has been less than expected in terms of new business developments and investments. The event did contribute to a stronger identity of the Greenport. The goals of the GVIC have been defined in terms of generating additional investment in the region. So far there seems to be the desired multiplier effect. Shortcoming of measuring outcome factors as an indicator for success is that it assumes investments leading to growth and development. It does not actually measure long term impact.

4.3 Greenport Zuid-Holland

4.3.1 External factors

Greenport Zuid-Holland is a cluster organisation located in the south-west of the Netherlands. The cluster is focused on the production, propagation and trade of horticulture and consists of three sub-clusters: vegetables, trees and flower bulbs. Prominent companies such as RijkZwaan, FresQ and Koppert Cress are located in this area. There has been an increasing challenge with regard to spatial planning, especially with regard to infrastructure and finding new space for growth. The cluster incorporates a highly heterogeneous set of horticultural companies – from the production of propagation materials to growers and international trade. Furthermore, a number of the suppliers and buyers of these products present in the cluster are amongst the most advanced in the world. Research institutes, such as Delft University and Wageningen UR, are also involved.

4.3.2 Internal factors

Because of the high involvement of local governments in the cluster organisation, there is a strong commitment from these stakeholders. The capability to engage with SMEs however, is a lot lower. Next to government, the most important stakeholder in the cluster organisation of Greenport Zuid-Holland is research institutes.

4.3.3 Key characteristics

Funding of the cluster organisation is project-based and mainly from public sources. These financial funds allow the cluster organisation to develop innovation-enhancing activities and innovation demonstration facilities within the project Greenport Campus. The main goal of the cluster organisation is to enhance the technological level of horticultural production in the area.

4.3.4 Fit

Dominant stakeholders – the research institutes – seem to be competing with each other for initiatives and have a low legitimisation with SME companies. For many of the

SMEs, the activities of the cluster organisation are either too general, or too focused on the frontrunners. As one respondent put it, "*there is not a clear innovation agenda for both innovators and the majority of entrepreneurs*". As a result tensions emerged among stakeholders, leading to a lower level of mutual trust. The fit of the cluster organisation is therefore perceived to be low.

4.3.5 Effect on cluster impact

The Greenport has generated results on various goals, for example infrastructure. As far as the innovation project is concerned the website states a list of succesful innovations (cases) by firms. Further data on impact are not available.

4.4 Food Connection Point (FCP)

4.4.1 External factors

FCP is a cluster organisation in the south of The Netherlands. The cluster consists of around 60 food production companies, among which the beer company Bavaria. The cluster is characterised by the dominant role of several regional entrepreneurs. Firms in the region suffered from a lack of skilled labour. Challenges in the external environment are quickly changing consumer needs and foreign competition.

4.4.2 Internal factors

In contrast to the greenport clusters, entrepreneurs took the initiative to found the cluster organisation. Local government, education and research institutes are involved whenever it seems appropriate. As a result, the cluster organisation has a strong capability to engage the food companies in the area and attract additional members. Members of the FCP cluster organisation pay an annual fee. This fee is one of the financial sources of the cluster organisation; the second stream originates from public funds.

4.4.3 Key characteristics

Originally, the main driver of collaborating in a cluster organisation was the increasing lack of sufficient skilled workers. Later, the goal to enhance innovation capabilities among cluster participants was added to the priorities. Funds have been used to organise activities for entrepreneurs and the development of a 'campus', where students learn in a business oriented environment.

4.4.4 Fit

While the involved companies reached a common goal and strategy with regard to human capital issues, on strategy with regard to improving innovation performance there is no clear consensus. One stakeholder remarked: "*it is difficult to develop a shared innovation agenda for all companies in the cluster*". So, while there is a solid fit on the issue of education and learning, the cluster organisation is still searching for a strategy on the topic of innovation. Internal fit is robust however, as the stakeholders involved have a shared background and culture and personal relationships are strong.

4.4.5 Effect on cluster impact

FCP reports the construction of two buildings: the ‘Groene Campus’ and ‘Food and Tech Park Brainport’, facilitating collaboration between education and firms and allowing testing of new products. FCP also created an umbrella organisation for experts on product development for food industry. Data on impact of these facilities, for example whether Campus actually led to more skilled labour, is not available.

4.5 Innofood

4.5.1 External factors

Innofood is the cluster organisation for a foodcluster in Twente (eastern Netherlands). This foodcluster has 90 members, all firms in the foodprocessing industry. Leading firms in the cluster are Grolsch, Johma, Bolletje and Zwanenberg. Also SMEs are active participants in the cluster. The involvement of research institutions in this area is low. The knowledge base is mainly systemic: firms adapt and reconfigure available knowledge and technology into improved products and processes.

4.5.2 Internal factors

The initiative to found Innofood has come from business itself. Innofood was founded in 1998. Allthough there are financial and human resources provided by members, resources are rather scarce.

Being founded by firms, the commitment of entrepreneurs is high. Other stakeholders, apart from educational institutions, have (not yet) been involved. At this moment the organisation is in transition, showing the willingness to adapt to new needs and possibilities.

4.5.3 Key characteristics

One of the founding objectives of Innofood was to attract motivated and skilled personnel for the industry. This is has become less urgent. Central theme now is initiating innovation. The main activities are capacity building in marketing and retail and networking.

4.5.4 Fit

The board of the cluster organisation consists of entrepreneurs and a representative from an educational institute. Based on the human capital goals from the past there was a good fit with the external environment. Needs have changed and Innofood is in a process of transition. It has still to be discovered whether there is still the necessary external fit. Internal fit is high, the organisation proves to be flexible and there is a harmonious atmosphere amongst the members.

4.5.5 Effect on cluster impact

Results are mainly formulated in terms of process and some output: number of activities, placement of interns, etc. Future goals are defined as the creation of new supplier relations and improved innovation capabilities.

4.6 Innexus

4.6.1 External factors

Innexus is a foodcluster in the northern Netherlands consisting of eleven member firms. The region is traditionally known for dairy. The cluster members are firms in food industry (baking and dairy products). There are some innovative, small firms specialised in components. There is an existing knowledge infrastructure, and an ambition to become a knowledge intensive, innovative region, competing with e.g. Food Valley. Apart from the knowledge institutions in respect to food industry, there is also a number of institutions specialised in health (one of the focal themes in the region).

4.6.2 Internal factors

Innexus was initiated by entrepreneurs. Starting in 2011 Innexus participated in Food Circle, a project organisation stimulating innovation in food and nutrition. Food Circle has more or less become the cluster organisation for the foodcluster in northern Netherlands. Innexus itself has limited financial resources brought in by member firms. Food Circle has project based financial, human and physical resources. Specific strengths of the cluster organisation Food Circle are the partnership in research and education, the presence in stakeholder networks on a political level, the ability to attract resources and the vast amount of technological knowledge.

4.6.3 Key characteristics

Strategic focus of Food Circle is technological innovation and research. The organisation is mainly project based, depending on current funding. Main activities are valorisation, challenging entrepreneurs and networking. Innexus itself continues to share experiences on human resources and other business topics on an informal basis.

4.6.4 Fit

In Food Circle a lot of stakeholders and donors are involved. Main stakeholders are research institutions, government institutions and service providers. The external fit might not be optimal because of a lack in compatibility of strategies and objectives. What is the long term common goal to which parties contribute? Also the internal fit might be threatened. Even though Innexus is one of the founders and target group, they do not feel like they have sufficient influence. Collaboration between partners is said to be difficult.

4.6.5 Effect on cluster impact

Several firms gained access to financial means (SME fund). A number of symposia were organised. No data on impact is available.

4.7 Greenport Aalsmeer

4.7.1 External factors

Greenport Aalsmeer is a cluster organisation situated in the west of the Netherlands. The main activities in the cluster are propagation, production and trade of flowers. Well-known companies such as Royal van Zanten are located in this area, as well as the largest flower auction in the world. As with Greenport Zuid-Holland, an important challenge are spatial planning issues with regard to infrastructure. Another identical feature of the cluster is the variety of companies located in the area: everything related to the production and trade of flowers. The presence of buyers from around the world, create the influence of sophisticated demand. In addition, several research institutes and educational organisations provide services to the entrepreneurs in the clusters.

4.7.2 Internal factors

The cluster organisation has both a permanent funding for the bureau and project funding to finance specific activities – e.g. with regard to enhancing innovative capabilities. Local governments initiated the founding of the cluster and are the main stakeholder in the cluster organisation to this day. Therefore there is a strong capability to engage other public stakeholders (e.g. central government) and business organisations, but less capability to reach SMEs.

4.7.3 Key characteristics

The cluster organisation defines knowledge and innovation as one of the goals. There are several projects stimulating innovation: 'Green Life Sciences Hub', 'Innovatiemotor' and 'Greenportcafés'.

4.7.4 Fit

The fit of Greenport Aalsmeer can be characterised as medium. While the participating stakeholders of the cluster organisation have a shared vision and complementary goals (governments, business organisations and research institutes), SME acceptance is relatively low. As one stakeholder stated: "*innovation-enhancing initiatives seem to reach big companies, but SMEs hardly profit from them*". Internal fit is relatively good on the other hand, as a result of a high mutual dependence – only through cooperation the goals of the cluster organisation can be achieved.

4.7.5 Effect on cluster impact

The efforts of the cluster organisation led to more visibility of the cluster and more access to project funding. Three innovation projects were created. No more detailed information on impact is available. Also infrastructural and political results were realised.

5 Analysis & discussion

In this paragraph the findings of the cluster organisations are compared and analysed – applying the conceptual framework.

5.1 Key characteristics of cluster organisations

5.1.1 Cross cluster analysis

Food Connection Point and Innofood are both making a shift from a focus on human capital issues towards a focus on innovation. Although Food Connection Point has more access to funding and therefore a larger activity portfolio, the type of activities for entrepreneurs are alike: networking and capacity building. These two cluster organisations are dominated by entrepreneurs. Both clusters are foodclusters.

The third foodcluster that was studied, Innexus, shares similarities of regional factors with Food Connection Point and Innofood. Also in this regional cluster, the local businesses consist of food companies. However, the goals of the cluster organisation are quite different. Innexus started with ambitious goals on innovation in the region and now participates in the project Food Circle, where technological innovation and valorisation are main topics.

There are some striking similarities between Innexus and Greenport Zuid-Holland. Both clusters have a strong presence of (technical) research institutes in the region, which have become dominant, also in the cluster organisations. Project organisations Food Circle and Greenport Campus, in which the research institutions have a leading role, are a large and influential part of the cluster organisations and activities. In the case of Innexus the project organisation has become stronger than the original cluster organisation set up by entrepreneurs. In the case of Greenport Zuid Holland, entrepreneurs have never been direct participants in the cluster organisation. In spite of these similarities the external factors differ greatly: Innexus is a foodcluster and Greenport Zuid Holland a greenport (horticulture), Innexus has a small and specific population, while the Greenport is aimed at a very diverse group of firms.

Greenport Aalsmeer, Greenport Venlo and Greenport Zuid-Holland are originally set up by government. Greenports have broad economic goals, which in the case of Aalsmeer and Venlo is also reflected in their innovation programmes, even though the clusters are very different (specialized firms, sectoral concentration and knowledge infrastructure in Aalsmeer and great sectoral diversity in Venlo). In the case of Greenport Zuid-Holland, the innovation programme is mainly technology driven. Research institutions are the dominant stakeholder in defining the innovation programme in Zuid-Holland. In both Aalsmeer and Venlo a structure is developed to include business in governance. In Venlo the innovation programme is governed by a board consisting only of entrepreneurs. All Greenports are funded by public funds only. The innovation programmes are all project based. Greenport Aalsmeer has a separately financed cluster organisation.

5.1.2 Discussion

There seems to be a general shift towards innovation from two sides. In the Greenports there is a shift from spatial planning and infrastructure towards innovation and the foodclusters shift from human capital issues towards innovation. This shift towards a focus on innovation could be explained by external factors, such as a prolonged economic downturn that forces entrepreneurs to innovate and a new economic policy that stimulates cluster organisations to enhance innovation.

Is it strategy that determines dominant stakeholder, or is it the dominant stakeholder that determines the strategy? At least in some cases it looks like the dominant stakeholder determines the strategy. For example, in case of Greenport Zuid Holland and Innexus the research institutes involved in the cluster organisation established a strong technological focus – independent of the sectoral and regional factors of the cluster. And what is the role of project funding? Where financial means are supposed to be an enabling factor, it seems when large projects are funded this can also be a disturbing factor in redistribution of power and interests. Project organisations becoming more powerful and even dominant in relation to the original cluster organisations. This raises questions on the long term effects, since project funding usually is temporary.

5.2 Fit of cluster organisations

5.2.1 Cross cluster analysis

Of the examined cluster organisations, Greenport Venlo performs best on fit. This is due to a balanced stakeholder composition in the cluster organisation; governments, businesses and research institutions share a common vision and developed congruent goals. Furthermore, SME engagement seems to be high, resulting in a high degree of trust and legitimation among agrifood entrepreneurs.

While Greenport Aalsmeer shares some similarities with Greenport Venlo on the key characteristics, the fit is comparatitavely lower. SMEs are not well represented in the cluster organisation and the engagement of entrepreneurs is relatively low. As a consequence, SME involvement and acceptance of the cluster organisation is less.

The foodclusters Food Connection Point and Innofood enjoy a high score on internal fit. The stakeholders involved in the cluster organisations – mainly businesses - share a common culture and there is a high degree of trust among the participants. Both organisations however, are still searching for a shared vision and agenda on innovation in the cluster.

Both Greenport Zuid Holland and foodcluster Innexus seem to experience a lack in internal and external fit. In both cluster organisations the players involved do not have the capability to engage and involve agrifood entrepreneurs in the cluster area. Furthermore, an overlap in incentives seems to cause rivalry among players participating in the cluster organisation. This has led to friction in personal relationships. Innexus has been overshadowed by other stakeholders and the project Food Circle.

5.2.2 Discussion

The challenge is to identify common challanges and opportunities which are legitimised by the entrepreneurs in the area. For Innofood it can also be questioned whether all stakeholders necessary for an effective regional innovation agenda are involved.

Achieving internal and external alignment of the cluster organisation is mainly determined by capabilities, culture, trust and personal relations and less by the specific external characteristics.

Setting regional (innovation) agenda's with the many stakeholders involved is a difficult task for any stakeholder who takes the initiative. Balancing concepts like collective and individual interests, long term and short term results, thinking and doing is challenging. Is it possible to build capacity and awareness in order to become more effective cluster organisations?

Even though innovation has appeared on almost all cluster agendas, it is not the only focal point for cluster organisations. Increasing productivity by a number of other interventions is just as much on the agenda. It does seem to be important, especially for innovation programmes, to ensure involvement of entrepreneurs in governance of the cluster organisations.

5.3 Effect on cluster impact

5.3.1 Cross cluster analysis

Data on the effect of cluster organisations on cluster impact are available in terms of input, process and output. One cluster organisation, Greenport Venlo, also measures outcome in terms of generated investments for the region. Indicators for impact are not defined or measured by any of the cluster organisations.

5.3.2 Discussion

In the conceptual framework relations between the characteristics and fit of a cluster organisation and the cluster impact are presented. The effect of the cluster organisations on the impact of the cluster is hard to assess. This is on the one hand due to a lack of data on factors like productivity growth of firms in the area, pace and direction of innovation and emergence of new firms in the cluster. If data were available it would still be difficult to attribute change to the cluster organisation efforts. Most monitoring and evaluation takes place on an input or process level, reporting on realisation of workshops, meetings or even building demonstration centers. Projects, activities and cluster organisations are at first means to an end, but in some cases tend to become goals in itself. Targets on outcome or impact level are often not defined and therefore poorly monitored. Both from a policy perspective and a scientific perspective this is an important shortcoming.

6 Conclusion

The explorative study provides answers on the three main research questions: (1) the variety of cluster organisations, (2) factors determining the variety and (3) the relation between the characteristics of a cluster organisation and its impact.

6.1 Variety of cluster organisations

Differences are found between cluster organisations operating in the field of primary production (the so-called greenports) and cluster organisations operating in the field of food production (the so-called foodclusters). Both types of clusters function in specific value chains and have a different perception of innovation. Second, it can be concluded that that cluster organisations differ in key characteristics and fit, coherent with the conceptual framework developed in this paper. Finally, a general shift in strategic focus of the cluster organisations is identified, towards the topic innovation.

6.2 Factors determining variety

This research finds several critical factors that explain diversity among agrifood cluster organisations in The Netherlands. First, both external and internal factors influence the key characteristics (strategy, activities and organisation) of the cluster organisations. From the external environment, the main determinants emerge from the sectoral and regional level – the environment closest to the cluster organisation. In addition, specific factors from the macro-level were identified, such as a new economic policy in The Netherlands. Fit (alignment of the cluster organisation with its external and internal environment) is mainly determined by internal factors such as personal relationships and trust. Another factor determining variety concerns funding. It can be concluded that a significant amount of funding for specific projects can lead to an imbalance between the project organisation(s) and the cluster organisation. This can result in an imbalance in power relations and a negative effect on the fit of the cluster organisation. The dominant stakeholder in a cluster organisation has a significant influence on strategic focus and activities. Therefore, a balanced involvement of stakeholders is crucial for external alignment, and therefore fit, of the cluster organisation. If innovation is the strategic focus the involvement of business and specifically SME is especially important.

6.3 Success of cluster organisations

The effect of a cluster organisation on cluster impact is often measured in terms of input, process and output. One cluster organisation measures outcome. Indicators for impact are not defined, let alone measured. It can therefore be concluded that there is a lack of information on the effectiveness of cluster organisations. The cluster organisation with the best fit, Greenport Venlo, was the only cluster organisation measuring outcome, resulting in a positive multiplier factor for generated investments in the region relative to inputs.

6.4 Research limitations

In this research, a limited number of specific clusters (Dutch agrofood clusters) were investigated. Consequently, the possibility to apply findings and conclusions to clusters in general is limited. Furthermore, the number of interviews per cluster in this study is limited, which is only adequate for explorative research. Conclusions need to be validated by further research including larger numbers of respondents. Finally, data on sensitive indicators for internal factors and fit need to be verified as these concepts are not yet operationalised adequately for empirical research.

6.5 Suggestions for further research

The conceptual framework presented in this paper provides a structure to analyse cluster organisations. It is suggested to further develop and empirically test the conceptual framework. In addition, more data on effect on cluster impact, fit and internal factors should be collected to allow analysis of cluster organisations.

6.6 Suggestions for action

Cluster organisations are recommended to not only define and monitor short term objectives in terms of input, process, output and outcome, but also use long term goals in terms of impact. Long term goals provide a sense of direction for the cluster organisation. Monitoring the effect on impact provides insight in the effectiveness of the cluster. Greenport Venlo shows that measuring and monitoring success, can not only be used to improve effectiveness, but could also be a promotional tool for attracting new resources for the cluster organisation. Furthermore, showing evidence of the impact of being in a regional cluster could increase the engagement of SMEs that are currently sometimes sceptical about the benefits of cooperation. In other words, measuring and monitoring impact should not only be seen as a requirement, but could also be an opportunity for promotion and enhancing engagement. Secondly, an effective cluster organisation has a good external fit, taking into account the very specific needs and possibilities of the cluster. Cluster organisations need tailor-made strategies, activities and organisations, matching the specific internal and external context. For example, a cluster can consist of a specific mix of entrepreneurs e.g. innovators, early adaptors and followers. Every target group for innovation support has its own characteristics and way in dealing with innovation and hence requires a tailor-made strategy to enhance innovation capabilities and performance. Third, a cluster organisation with the goal to enhance innovation among SMEs is recommended to directly involve entrepreneurs in the governance of the cluster – in order to align interests and enhance engagement. Fourth, funding can be an enabler for cluster organisations to create impact, but it can also lead to a shift in power relations and interests. Specific project funding can put a strong emphasis on short term project goals. It is recommended to be aware of the possible effects of funding on the organisation. Relating projects to long term objectives in terms of cluster impact helps to maintain balance. Finally, it is a challenging task for cluster organisations to achieve an impact in the regional cluster. Especially since cluster organisations deal with multi-stakeholder processes, and with a number of goals and interests on various levels. An independent, intermediary organisation can be of value for cluster organisations by e.g. connecting stakeholders and facilitating agenda-setting.

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The Lead User Method, Success Explained And Remarks On Futher Research

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Abstract

The Front End of Innovation (FEI) is the beginning point of any innovation project. The execution of the FEI plays a crucial role in developing new products. In literature, we discovered all sorts of innovation types with various definitions which make it difficult to clearly communicate within academics and as practitioners. We do, however, see a relationship with anomalies employed by Christensen, therefore, we directed our focus toward these. Earlier research has also proven that the Lead User Method is a very effective and efficient method for creating radical innovations. In this study, we employ case-based studies to support the reason why this method seems to be successful. With literature reviews on the Front End of Innovation and the Lead User Method, we emphasize the key success factors of these processes. Within existing literature, we were unable to find an FEI method with any significant conducted research.

We were often disappointed about the interpretation of the term “Lead User”. It was also surprising because von Hippel defines Lead Users quite clearly. In Lead User practices, we perceive two types of executions of which both were positively evaluated by practitioners. This is interesting because the executions are different and vary from the original approach of von Hippel. These types of executions diversify according to the role of a facilitator and an outsource variant. For further research, we focused on the facilitators’ role and the possibility of outsourcing Lead User projects.

To improve theory building, we utilize the ideas of van de Ven, i.e., Engaged Scholarship, and Christensen with the ongoing process of building a theory of disruption. For executing research, we employed the principles of Action Research to bridge the academic and industry worlds. With our suggestions for further research, we hope to contribute to the research agenda of Hustad and research questions from O’Conner.

Keywords

Lead User Method, action research, front end of innovation, innovation process, radical innovation.

1 Introduction

Radical innovation is required for long term continuity of a firm. This type of innovation is a costly business process with an uncertain outcome. The most significant benefits can be achieved through improvements in the performance of the front-end activities (Khurana and Rosenthal 1998). A well-structured innovation method can contribute to successful innovations.

In literature, a specific FEI method, the Lead User Method, has received significant attention in research (Von Hippel 1986). The Lead User Method was developed by von Hippel and has been used successfully by certain researchers in practice (Siouzou

2005). What is not yet clear from literature regarding this method is an explanation for its higher effectiveness. Can we link key success factors to the Lead User Method? In literature, we discovered two types of Lead User practices. Both types deviate in some aspects from the original approach of von Hippel, as described in his handbook, yet, both seem to be successful in practice. What are these deviations, and what can we learn from that? An in-depth exploration into these deviations will be conducted in an attempt to explain why these are interesting for further research and what contributions can be made to the profession's development in innovation management. In our conversation with von Hippel, he mentioned that, over previous months, more questions have risen regarding the Lead User Method. It appears as though practices are searching for methods that will improve the innovation process.

We begin with an overview on innovation literature with remarks regarding previous research. We then focus on the FEI as a phase of the innovation process. What key success factors have researchers discovered, and what does it mean for the FEI phase? In this, paper we will search for answers to these questions.

With our work, we hope to contribute to improving the profession's development in the domain of New Product Development. Hustad, president of PDMA in 1981 and founder and longtime editor of the Journal of Product Innovation Management, is of the opinion that, by creating a research agenda, it will, at least in part, strive to inform choices of topics that will assist researchers in continuing to advance professional practices (Hustad 2012). We confer with him and, from that perspective, focus on certain aspects from his list of topics.

In order bridge science and industry, we conduct our research in an Action Research mode, which is a special form of research. This approach, according the vision of van de Ven, is Engaged Scholarship (Mahoney and Van de Ven 2008). Engaged scholarship and Action Research are participative forms of research used for obtaining the counsel and viewpoints of stakeholders. Our goal is to increase knowledge, formulate theories, and facilitate management of organizations in an attempt to improve their innovation processes.
The University Industry Innovation Network is also intended to improve the relationship of science and business by creating a platform where researchers and practitioners can meet each other and share their experiences, which also contributes to professional development.

In the process of building theories, we concentrate on certain concepts of Christensen with a special focus on the phenomena of anomaly (Christensen 2006). It is only when an anomaly - an outcome for which theory cannot account – is identified that an opportunity occurs to improve theory. A source of misunderstanding for both academics and practitioners in building and using theories and creating knowledge development can be attributed to anomalies. In this paper, we pay particular attention to this subject. We believe that, by bridging science and industry, anomalies can be discovered much earlier and improve professional development.

2 Literature review

2.1 Focus of innovation

In 2001, Peter Drucker was very clear in his book “The essential Drucker”, stating that the purpose of a usiness is to create a customer, and the business and has two– and only two- basic functions: marketing and innovation. What the customer buys and considers of value is never just a product. It is always a utility, that is, what a product or service does for the customer. We conclude from Drucker’s opinion that an innovation process must have a focus on customer needs (markets) and delivering products/services (technology).

Innovation literature indicates certain types of strategical approaches such as marketing pull where the customer requests a product and “pulls” it through processing to delivery, and technology push, whereby, the manufacturer of a product decides the production level. The technology push approach is, very often, employed but also, very often, a failure. In our practical experience, we have evidenced technicians who have the lead in developing innovations while very seldom involving marketers in the innovation process. The result is nice products without really meeting customer needs. As indicated by Drucker, the purpose of a business is to create a customer. From that perspective, marketing pull can be the only approach to bring successful innovations to markets. The focus must be on “the job to be done” (Christensen, Anthony et al. 2007).

A shortcoming in many innovation projects is a lack of voice-of-customer research, solid market information, and sharp, early product definition (Cooper, Edgett et al. 2004). What is confusing in literature is the meaning of the contribution of “the voice of the customer”. In developing incremental innovations, the users, but also suppliers or other stakeholders, can contribute to the developing process. The knowledge and experience from these people can be transformed easily into the organization of a product. However, the knowledge and experience required for radical innovation during the FEI is very different. Research has shown that average users usually cannot dictate with any accuracy what they will want in the future. They often can only speculate about their future needs as indicated in a quote from Henry Ford: “If I'd asked customers what they wanted, they would have said faster horses." Users living in the current time period are not appropriate sources of information for radical innovations during the FEI.

Von Hippel discovered users who are “living in tomorrow’s world”. These leading edge users, Lead Users, have proven to be a much richer and more accurate source of information regarding future market needs than “routine” users because they are actively grappling with the inadequacies of existing products and services (von Hippel et al., 2009). With the support of Lead Users during the FEI phase of a radical innovation process, the project team must be able to gather market information and technology information which will result in product or services concepts.

Do existing users have any role at all in the FEI? Yes, they have. They are the sources for research on “the job to be done”. Customers will always purchase a utility, i.e., what a product or service does for him. As in the approach indicated in the research work of Levitt (Levitt 1960) ,Ulwick (Ulwick 2002) and Christensen (Christensen, Cook et al. 2005), do not ask customers what they want, but see what they are doing.

The task for management must be focused on the continuity of the firm. Their attention must be focused on the different time fences, i.e., short time and the future. Decisions made for the short time and future must be in line. Different types of innovation can be assigned to these different time fences (Song and Montoya-Weiss 1998; Veryzer 1998; Garcia and Calantone 2002; Verworn, Herstatt et al. 2008). Incremental innovations are focused within the short time, and radical innovations are long term. Though radical innovations seem to be the most profitable type of innovation, they are also the most risky. The results of radical innovations are future opportunities; however, the costs are current which creates a dilemma for expense managers. Management cannot avoid developing radical innovations because of this dilemma, however, as the radical innovations create a foundation of future success.

Why is there, often, a policy of radical innovation missing in the boardroom of organizations? One explanation can be determined by the high risks attributed to radical innovations. In order to control this risk, a high quality innovation process is required (Cooper and Kleinschmidt 1987; Cooper and Kleinschmidt 1995). A high quality innovation process must be effective and efficient with a focus on reducing risk. By reducing this risk factor, researchers can assist management with their task to create continuity for the firm. Despite of all the research in the last decennia regarding innovation, it appears that this research work does not really contribute to creating successful innovations. The risk factor for management has not been reduced (Stevens and Burley 2003).

What we learned from literature is that creating radical innovations is indispensable for the continuity of a firm, a marketing pull approach is required, and the risk factor must be reduced. The role of the ordinary customer in the FEI phase is reduced to a source of information and focused on “the job to be done”.

2.2 Innovation process and FEI

What is clear from the literature is that innovation processes can be divided into three phases: Front End of Innovation (FEI),New Product Development (NPD), and Commercialization of Innovation (CI) (Figure 1) (Koen, Ajamian et al. 2001).

Each phase possesses its own characteristics, approaches and impact on the risk factor. Earlier research is not always clear about what phase or phases that scholars are publishing. Do they mean the entire innovation process or a partial phase of the innovation?

Theory or knowledge concluded from one of the phases cannot only be applicable for the whole process or other phases.

Publications also depict all sorts of innovations types (Garcia and Calantone 2002). Most common are incremental innovation and radical innovation. These types of innovations possess their own characteristics and require different approaches, however, in literature, it is not always clear what type of innovation has been researched by the scholar.

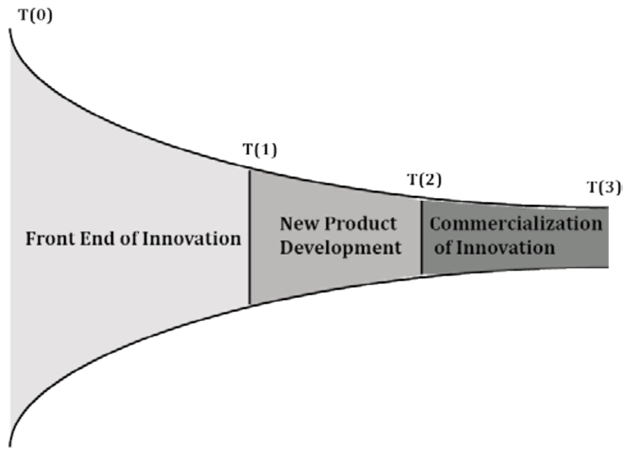

Fig. 1: Phases of an innovation process

In this paper, we focus on the FEI for radical innovations. In spite of all of the research work, in our practice, many organizations still have a significant problem in creating successful radical innovations. Creating successful incremental innovations is not really a notable issue. Network, processes and resources required for incremental innovations are more in line with the usual production process and organization of the firm. For creating radical innovations, organizations are, most of the time, not equipped for such a process. They are missing the correct process, the correct people, the right network, and the experience to complete the job. Developing radical innovations are risky projects and related to future unknown revenues, and the execution of the FEI phase significantly influences the total result of radical innovations. When organizations can employ a proven concept of the FEI phase, this will assist management in creating successful radical innovations. A favorable method of an innovation process is focused on reducing uncertainty, both in markets and technology, however, in this study, we focused on the Lead User Method as developed by von Hippel (Von hippel 1986), which appears to be a successful approach.

The Lead User Method is not a well-known method and is not generally utilized for creating radical innovations. Extensive research has been conducted regarding this method, and it seems that, when employing this method, organizations are able to take radical innovations successfully to markets. Scholars have proven the existence of Lead Users as sources of innovations and that they can be used in a successful way during the execution of the Lead User Method. We will search for answers as to what makes this method successful as this is not clear from the literature.

2.3 A successful FEI process

The FEI phase, a research phase, begins with the innovation vision of management (Cooper, Edgett et al. 2004) and is completed with a description of the business case. Smith and Reinertsen where the first scholars to mention this phase as the “Fuzzy Front End”(Smith and Reinertsen 1992). We concur more with scholars who mention this phase as the “Front End of Innovation”.

The FEI phase can be seen as homework needing to be completed. It is all about knowledge creation and sharing and connecting the outside world with the inside world. In regard to incremental innovation, this world is more in line with the existing elements such as processes, resources, and networks. Radical innovation processes, however, require a completely different approach and are much more risky. Available resources and existing networks are not sufficient to create successful radical innovations. The approach of the FEI by scholars and consultants is more an idea generation process that begins with brainstorming and “out of the box” thinking. We have not discovered any confirmations contained in literature indicating that this approach delivers more and/or improved ideas for innovation.

A successful innovation process depends on the effectiveness and efficiency of the process. As indicated by (Cooper 1999), “Doing the right things and doing the right things right.” The most important issues for innovation are summarized by Cooper (Cooper and Kleinschmidt 2007):

The existence of a high-quality, rigorous process-one that emphasizes up-front homework, tough Go/Kill decision points, sharp early product definition, and flexibility;

(1) Having a new product strategy;

(2) Resources-both people and money-are strongly tied to new product performance;

(3) Quality of the project team.

NPD projects precede opportunity analyses, assessment of market attractiveness, market research, and financial analysis (Murphy and Kumar 1997; Khurana and Rosenthal 1998; Veryzer 1998). Cooper is calling this “up-front homework”. The beginning point of up-front homework is communicating management’s vision clearly to the organization (Reid and de Brentani 2012) as this vision results in a new product strategy. We discover the undeniable connection of business strategy and innovation strategy in that, if reduced time-to-market and quality-of-execution are the goals to be realized, resource allocation and focus must be top priority (Cooper, Edgett et al. 2004). Having a clear and new product strategy, also indicated in literature as Market Vision (MV), is also a key success factor for radical innovations (O'Connor and Rice 2001; de Brentani and

Reid 2012; Reid and de Brentani 2012) as well as having a multi-disciplinary team. The team has a minor impact on the project result, which is not as expected. Instead, the quality of the team and the leader, a “product champion”, is more crucial (Cooper and Kleinschmidt 2007).

What we conclude from the research of Cooper et al. is that an innovation project is manageable (Drucker 1985). Practices demonstrates that many activities executed during the innovation process are poorly executed which results in a high failure rate of new products.

2.4 The Lead User Method for radical innovations

We discovered a method contained in certain literature for the FEI process, the Lead User Method, a very successful method for delivering products or service concepts. This method is developed by von Hippel and was employed for the first time by Herstatt at Hilti AG. (Herstatt and Von Hippel 1992). Many researchers have conducted case-based research work on this method and confirm positive results (Urban and Von Hippel 1988; Lilien, Morrison et al. 2002; Luthje and Herstatt 2004; Franke, von Hippel et al. 2006; Lettl, Herstatt et al. 2006). Literature also substantiates that many companies have also successfully utilized this method (Siouzou 2005; Eisenberg 2011).

The term “Lead User” is not always employed correctly in literature which causes confusion. Von Hippel defines Lead Users as individuals or firms who display both of the two characteristics below (Urban and Von Hippel 1988).

› Lead Users have new product or service needs that will be general in a marketplace, but they face them months or years before the bulk of the market encounters them;

› Lead Users expect to benefit significantly by finding a solution to their needs. As a result, they often develop new products or services themselves because they are unable or unwilling to wait for them to become commercially available.

Lead Users are not to be confused with routine customers or early adopters as defined by Rogers (Rogers 1993).

Von Hippel distinguishes three different categories of Lead Users with different contributions to the innovation process. Each category contains its own type of information. Three types of Lead Users are:

› Lead Users in the target application and market;

› Lead Users of similar applications in advanced “analog” markets;

› Lead Users with respect to important attributes of problems faced by users in the target market.

The Lead User Method is a well-defined four stage gate method for the FEI process. The Lead User Project begins with the focus and overriding goals of the innovation initiative as formulated by management. The result of the project is a well-defined concept or concepts of products or services that are relevant to move further into the NPD phase. The four stages of the Lead User Method are depicted below (Figure 2).

Fig. 2: Stages of the Lead User Method

The project team must be a very talented team. A multi-functional project team consists of people from both the marketing and technical departments with one member serving as the project leader. The project team must communicate each stage to management for either rejection or acceptance. At this point, project teams can share all types of information with management.

The FEI process relies on the acquisition of knowledge from the outside world in order to better inform the project team and the organization. Von Hippel indicates that this "sticky" information is a source of creating knowledge that is useful for the FEI process (Von Hippel 1994) and can be obtained for the project employing interviews, ethnography and workshops.

Lead User Method topics in literature include the existence of Lead Users, Lead Users as sources of innovation, the process of searching for Lead Users, case-based studies of Lead User projects, and performance of Lead User Projects.

Based on a clearly defined project focus and goals and the systematical manner of gathering information, the project team is able to define clear product concepts which can then be transformed into successful radical innovations.

2.5 Types of Lead User Method practices

Von Hippel describes a very clear execution of a Lead User project: "Lead User Project Handbook: a practical guide for Lead User project teams". In practice, two types of schools are evident in using the Lead User Method. One type is comprised of firms creating a multi-disciplinary project team complete with a facilitator (a researcher or a consultant). The other consists of firms outsourcing the FEI to outsiders (students of universities) being assisted by a facilitator (researcher) and supported by employees of the client. Both approaches appear to be successful (Siouzou 2005). It is interesting to note, however, that information regarding a project led by consultants is not described in the handbook.

In European practices, it appears that Lead User projects are frequently facilitated by researchers from German, Austria and Denmark. What is interesting is that most of these researchers have a direct connection with von Hippel (Siouzou 2005). During Lead

User projects, these researchers fulfill a sort of facilitator role. What is not clear from the literature is why these Lead User Projects are successful and what differences are evident from these two approaches at the completion of the FEI process and at the end of the entire innovation process. What is the impact of the Lead User Method on the process of creating a successful radical innovation? What impact does the facilitator role play on the success? Outsourcing possibilities for practices may also be interesting to study. What are the consequences of such an outsourcing approach? These are subjects for further research.

In this paper, we provide answers based on literature from case-based practices as to why Lead User Methods are successful. Based on earlier innovation processes research, we searched for key success factors. Further research is required to find in depth explanations.

3 Lead User Method a case-based explanation for success

Research on the Lead User Method indicates that this method is very effective and efficient (Herstatt and Von Hippel 1992; Lilien, Morrison et al. 2002) (Siouzou 2005). Literature, however, does not clearly indicate the reason why this method is so successful in practice. It is true that ingredients for success are embedded in the process, but we believe there must be more. Can we find some beginning points for answers from earlier research on innovation processes?

The project beginning of a Lead User project is the formulation by management of the focus and overriding goals of the innovation project. This is in line with findings of Cooper et al.(Cooper, Edgett et al. 2004; Cooper and Kleinschmidt 2007) which link business strategy and the new product strategy to the innovation project. After formulating goals and the focus, management must install a project team consisting of members from both the marketing and the technical departments (Kim and Wilemon 2002). Success of the project relies heavily on constructing a very talented team. Cooper et al discovered that the multi-disciplinary team was not the major key success factor but, on the contrary, it is the quality of the team that matters most. From earlier research of Cooper et al.(Cooper, Edgett et al. 2004; Cooper and Kleinschmidt 2007) and Stevens (Stevens and Burley 2003), it is evident that the quality of the project team and the project leader or “product champion” have a significant impact on the quality of the innovation process. For Lead User projects, von Hippel recommends that, at a minimum, the core project team members devote approximately 30-50% of their work time to the project. This is approximately 15-20 hours dictated toward completing project related activities. Assigning the needed resources to an innovation project was one of the key success factors (Cooper and Kleinschmidt 2007).

The project team begins by culminating information from customers and experts focused on “the job to be done”. This step is concentrated on formulating a Market Vision. A beneficial Market Vision has demonstrated as being supportive of firms in achieving a significant competitive advantage (Reid and de Brentani 2010). This is also evidenced by Levitt, Ulwick and Christensen (Levitt 1960; Ulwick 2002; Christensen, Cook et al. 2005).

Another important aspect is obtaining relevant information from the outside world and combining that information with knowledge inside the company. Newly acquired information must be shared with corporate-level decision makers, i.e., the management (Reid and de Brentani 2004), as radical innovations sources of information are mostly far removed from their own networks. At the completion of each stage during the FEI, the project team contacted the management of the firm to share their knowledge and discoveries. In that manner, the project team fulfils the roles as boundary spanners and gatekeepers which have an important impact on the success of an innovation project.

The trend analysis stage can be built on the clear Market Vision formulated by the project team and approved by management. For this stage, Lead User and experts are the most important sources of information as these informants possess tacit knowledge, i.e., individual knowledge that is not publicly available (Leonard and Sensiper 1998), related to discovering the problem.

The Lead User stage will be employed by the project team in order to search for people who have tacit knowledge, are willing to contribute, and are in a position to assist the team during the problem solving process at the workshop stage. In our meeting with von Hippel, he emphasizes that a Lead User could always be found; there are always trends, and people always exist up-front with these trends.

The workshop stage creates an atmosphere where selected Lead Users and employees searching for product concepts collaborate. This circumstance makes it possible to share tacit knowledge. The workshop group is working on clearly specified problems and searching for promising concepts, and tacit knowledge is a tremendous resource for all activities, especially for innovation (Leonard and Sensiper 1998). Employing tacit knowledge from people who are living in “tomorrow’s world” positively impacts the success of radical innovations. This distinguishes the Lead User Method from other approaches of radical innovations.

4 Further research and approach

Case-based studies demonstrate aspects of the Lead User Method which can explain the success of the method for creating radical innovations. What is not clear is the role of facilitators during Lead User practices. What impact do they have on management, the project team, and the process? What is the possibility of outsourcing the FEI project, and what is the impact on the quality of the project? These are subjects for further investigations. In the next paragraph, we explain our vision on theory building and the approach for our research work.

Our approach for research is the Action Research mode. Theory is useful when it declares history but can also forecast future outcome. It was Christensen who focused on Anomalies as part of theory building. The building of theory occurs in two major stages: a descriptive stage and a prescriptive stage. Within each, theory builders proceed through three steps (figure 3) (Christensen and Carlile 2009). Research and practice iterate through these three steps again and again, and collaboratively build better theory. Within the action Research mode we want to reinforce the collaboration and improve theory building. Anomalies are valuable in theory building because the discovery of an anomaly is the enabling step to less ambiguous description and measurement and to identifying and improving the categorization scheme in a body of theory. By Researchers who seek to surface and resolve anomalies, therefor, tend to advance their fields more productively than those that seek to avoid them (Christensen and Carlile 2009). An approach like this contributes to the professionalism development of our research field.

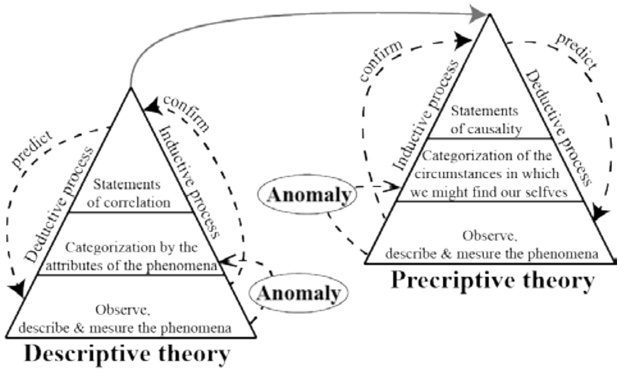

Fig. 3: Model of theory building

In innovation literature, this critical attribute is too often omitted which creates diffusion in innovation theory building and the spreading of knowledge (Keupp, Palmie et al. 2012). Influenced by van de Ven (Mahoney and Van de Ven 2008) and Christensen (Christensen 2006; Christensen and Carlile 2009), it is apparent that Action Research can contribute to theory building and collaborating with practices (Aagaard 2012). From that situation we can develop theories, test the theories and contribute to the valorization of knowledge. Anomalies are not a failure in theory but are generally the key to discover problems in definitions and measurement and in formulating improved categorization schemes (Christensen and Carlile 2009) in regard to the category of conducted innovation research , either radical or incremental innovation, or what phase the innovation process, FEI, NPD, or CI is in. Garcia and Calantone discovered all types of definitions for innovations, which makes it difficult to communicate clearly with academics and practitioners (Garcia and Calantone 2002). Therefore, there is no better way to discover anomalies than by working close in practice which provides the platform to build and improve theory but also to spread the knowledge to practitioners.

In order to cohesively unite the university and industry, there must be a common or congruent goal. Our offer is to facilitate industry in creating innovation projects. The common goal is to improve innovation processes, resulting in successful new products. The congruent goal for researchers is to build theories and create useful applications. The congruent goal for industry is creating continuity by selling profitable products or services. As facilitator, our role is to support firms and conduct research work in the same projects (Middel, Coghlan et al. 2006).

Our first action is to acquire Lead User projects in industry. With these projects, we want to conduct research on the role of a facilitator and the possibility of outsourcing Lead User Projects. What differences can we observe and what constrains must be formulated when employing the Lead User Method in different circumstances in order to create successful innovations?

With our research, we contribute to some of the topics included in the research agenda posted by Hustad (Hustad 2012). The possibility of outsourcing the FEI can be seen as a new research item in the domain of innovation. No research regarding this item was found. The purpose of conducting research on the facilitator role is to formulate suggestions for management to incorporate a function such as an innovation manager (O'Connor 2012). O’Connor formulated certain questions related to theory building in the domain of innovation: What are the areas of knowledge generation that will advance the theory and practice of NPD and innovation management? Are we, in actual fact, studying innovation? Is the NPD process innovation, or is it part of the on-going operational excellence and customer intimacy aspect of the business? Looking to the various types of execution of a Lead User Project in an Action Research mode, we hope to find answers and contribute to the profession’s development in the domain of innovation.

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New Forms Of Regional University Engagement: Evidence From Germany

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Abstract

More recently, the contribution of German universities to regional development or their „third role“ is particularly pronounced by the fact that the range of their tasks as well as their autonomy has increased significantly. Terms like new public management principles, self-control and strategic management underline this new role. Against the background that universities more and more become corporate organizations, combined with the fact that new funding initiatives by the German government have been introduced, the objective of the paper is to analyse the recent developments of universities with regard to the regions they are located in. Of special interest will be the identification of the most prominent forms of regional engagement, the analysis of new organizational structures and the governance mechanisms currently introduced. Based on a large survey among German professors and the management levels of universities and by introducing the ResearchCampus Programme recently im-plemented by the German government, the paper shows that multilateral, multi-functional networks and long-term institutionalized partnerships are increasingly establishes. However, these new and comprehensive approaches require completely new organizational and management capacities.

Keywords

Regional engagement, university autonomy, research collaboration, research campus, Germany

1 Objective of the paper

Due to the dynamic character of innovation processes, innovation systems have to continuously adapt to new challenges and competitive change. Although path dependency results in quite stable organizational structures over a certain period of time, organizations themselves and interfaces between them change more frequently (Fraunhofer ISI, 2012). This process is also related to the university system and its transfer activities. As a matter of fact, a substantial academic debate has taken place around the implications this may have on the role of higher education in society. One particularly common hypothesis in this regard was that the shift towards "Mode 2" of knowledge production (Gibbons et al., 1994; Martin, 2010) would facilitate the evolution of a more pronounced "third role" of universities. An important aspect of this third role is related to their active contribution to regional development (Gunasekara, 2004; Westnes et al., 2007). Besides, the notion of a "third role" was introduced to unite a number of different discussion strands ranging from 'community service' (OECD, 1999), 'regional development' (Goddard and Chatterton, 1999), 'regional engagement' (Holland, 2001), to 'regional innovation organisation' (Etzkowitz, 2002) and 'academic entrepreneurialism' (Etzkowitz and Leydesdorff, 1999). Related to these developments, new organizational possibilities have been opened which allow universities to act as strategic actor by their own. In this context, the emergence of "entrepreneurial universities" or the "boundary-spanning roles" of new university units (Youtie and Shapira, 2008) are being discussed.

In this context, the range of tasks of German universities has increased significantly during the last 10 to 15 years, but without a corresponding increase in allocated financial resources. Due to the increasing university autonomy, new public management principles have been applied to the universities, self-control has been enhanced and strategic management principles have been introduced. Examples of new university engagement are the participation in cluster initiatives as one of the most prominent knowledge hubs, or the collaboration with industrial companies in strategic research fields in a long term perspective. Many of these activities take place in the regional context, often not in account of internationalization strategies, but in their addition.

The objective of the paper is to analyse these recent developments, to identify the most prominent forms of (regional) engagement of universities, to detect whether this form of engagement results in the evolution of new organisational structures in the German science and research system, and to draw conclusions about the scope of action the university administration has in the governance of new forms of regional engagement.

2 Theoretical and empirical background

While over many years the role of universities in their respective regions largely remained unnoticed in Germany, the aspect of regional integration and networking is now being assessed as a relevant aspect in science and innovation policy (Schiller and Kiese, 2010; for an international perspective see Goldstein and Glaser, 2012). Since the amendment of the Higher Education Act in 1998 which allocated knowledge and technology transfer in addition to research and teaching as a third activity to the key tasks of universities, the dimension of regional networking in the process of individual strategy formation of individual universities gained importance (Kitagawa, 2009; Sondermann et al., 2008). In parallel, universities received stronger attention both from national and regional policy actors since the mid-2000s (Koschatzky et al., 2013).

In this respect, some authors point to the fact that universities become actively acting organizations by themselves in the context of a changing governance environment, compared to their role of publicly controlled objects in the past (Krücken et al., 2009; Krücken and Meier, 2006; Nickel, 2004). Discussions about "entrepreneurial universities" (Clark, 1998; Gibbs, 2001) reflect this new role and the increasing diversity in activities and organizational modes of German universities. These role models and the related explicit development of strategies for the implementation of regional activities are fairly new to German universities, compared to the activity profiles, for example, of US American, British or Australian universities (Abramson et al., 1997; Charles, 2003; Gunasekara, 2006; Premus et al., 2003). Among other things, new competence fields and activity profiles developed which are also reflected in staffing strategies for the management level of universities (Krücken et al., 2009).

In recent years, therefore, German universities have been subject to rapid changes with regard to regulatory framework conditions, and expectations expressed by political actors which favour regional engagement for different reasons. Consequently, some professors as well as the administrations of universities have developed strategic approaches in order to improve regional engagement and partnerships. In these partnerships,

- a wide range of public and private partners are included, namely research institutions, public and political authorities, enterprises, as well as societal actors or third sector organizations,
- multilateral partner constellations often develop, and
- not only ad-hoc, short-time collaborations are covered, but increasingly also long-term partnerships which are institutionalized in different forms (e.g. in public-private-partnerships).

The forms of coordination and control of activities which emerge in this context depends on the increasing differentiation in the university system and on the existing regional integration and the academic profile of the respective university (Boucher et al., 2003; Power and Malmberg, 2008). It is expected that the measures might lead to the formation of different types of universities with specific regional foci. Nevertheless, there is little empirical work in this field so far. This can be attributed to the fact that most of the relevant strategic processes were completed either not yet or only recently (Krücken et al., 2008). Therefore, only a few surveys deal with the analysis of regional activities of universities so far. Regional science research often focuses on the microeconomic detectable effects of regional engagement of universities that are implicitly attributed mainly to the cooperation of universities with regional firms as well as human capital transfers (for an overview see Voss, 2004). It was also shown in other studies that within this general cooperation pattern universities of applied sciences (technical colleges) are oriented much stronger towards their close spatial environment than universities (Fritsch et al., 2007). What other forms of activities exist is often not investigated further.

In order to map the regional activities of universities in an adequate manner, it is necessary to include forms regional engagement which go beyond the classically examined fields of technology transfer, university teaching, and the execution of technology-oriented cooperation projects. A basis for such an overview representation is provided by Benneworth et al. (2009), who describe different types of university engagement. Although not intended, a regional focus is visible in these kinds of activities, because ‘knowledge travels on legs’ (quoted in Benneworth, 2009: 2). Many (but not all) of the activities take place in the regional environment. On this basis, a typology of university networking has been developed which is based on the core activities of research, knowledge exchange, services, and teaching (cf. Table 1). The following analysis is based on this typology

Types of university activity		**Main areas of engagement**
Research	R1	Collaborative research projects (in the sense of technology transfer to industry)
	R2	Research projects aiming at a knowledge gain for all partners (mutual exchange, common knowledge generation)
	R3	Contract research
	R4	Research on such groups which include a feedback to these groups
Knowledge sharing	K1	Consultancy
	K2	Public funded knowledge exchange projects
	K3	Measures of competence building at regional actors
	K4	Knowledge sharing through student "consultancy"
	K5	Participation at public dialogue and media discourses
Services	S1	Making university assets and services accessible
	S2	Support hard-to-reach groups at the use of assets
	S3	Intellectual expert contributions
	S4	Contribution to civic life of the region
Teaching	T1	Teaching appropriate engagement practices
	T2	Practical education for citizenship
	T3	Public lectures and seminar series
	T4	Further education for hard-to-reach groups
	T5	Adult and lifelong learning

Table 1: Typology of university engagement (adapted according to Benneworth et al. (2009: 6)

In this paper, two empirical approaches are combined. It draws firstly on an empirical study carried out in 2005/2006 among institutes associated to a university and at that time recent new organisational modes of strategic research collaboration between universities and mainly larger enterprises in Germany (Koschatzky et al., 2008; Koschatzky and Stahlecker, 2010). This study provided the historical basis for two recent empirical studies. One is related to the kind and intensity of regional engagement by university professors and the strategic objectives of the leading decision levels of universities, i.e. presidents and deans (Dornbusch et al., 2012; Koschatzky et al., 2013).1 This survey was addressed to 14,023 professors via an online survey, to 1,435 deans and 366 presidents/vice-presidents via a postal survey. Around 1,600 professors replied, while 482 deans and 176 presidents filled in the postal questionnaires. The second field work activity is the evaluation by Fraunhofer ISI of the ResearchCampus programme (RCP) of the Federal Ministry of Education and Research (BMBF), which started in September 2012. A research campus is characterized by a combination of three features: the pooling of the expertise of industry and public research in one location (i.e. at or close by a campus), the treatment of research topics in the medium to long term perspective, and a mandatory public-private partnership. The programme funds ten research campus models at German universities or non-university research institutes over a period of a maximum of 15 years with a budget of a maximum of 2 million Euro per research campus per year. Based on personal interviews with the responsible people from industry and universities in each research campus, expectations, assessments and possible implications of this kind of activity are continuously collected and analysed.

3 Regional engagement of universities in Germany

The data collected from German professors and the management levels of universities show that there are different forms of regional engagement of German universities and also different motives for this engagement. Regional engagement is a relevant activity for German universities: 79.3% of presidents and 64.9% of deans reported an increased participation of the professors at their institution in regionally-oriented activities over the past ten years. Universities seem to cooperate mostly with organizations which are not belonging to the group of universities. Companies are the most frequently chosen partners for regional cooperation (35.1%), closely followed by public institutions like federal, state or local organizations (29.9%). Theses numbers empirically underline the involvement of a wide range of public and private partners.

The motivation for establishing regional relationships is rooted in several interrelated reasons, namely attracting external funds (with regional companies acting as contracting partners), striving for excellence in research by building strategic partnerships with public as well as private stakeholders or contributing to regional development involving local organizations and companies alike. Internal amendments regarding attractive conditions for students and employees for instance also play a major role. We also found out that the motivations for regional engagement are mainly of intrinsic nature. The setting of incentives for regional activities through financial and other es in German universities is not a common practice yet. In cases in which the university

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management wants to increase the motivation of their professors for regional activities, this was done especially through financial incentives, as well as by duced teaching load (this especially in technical colleges). It becomes clear that the university management has some possibilities for providing incentives, but this is mainly the case when regional engagement is part of a centrally coordinated strategy. The amount and intensity of regional activities depends also on the disciplines. Contributions to civic life are mainly rooted in the social sciences, while collaboration (with industry) and exchange of personnel is a general practice in the engineering sciences.

While specific types of regional engagement in individual cases may be motivated quite differently, it can be assumed that the activity types described in Table 1 can be grouped along fundamental intentions. Against this background, the latent, i.e. not directly measurable regional engagement structures should be determined analytically. In order to capture these interrelations statistically, a factor analysis of the variables shown in Figure 1 with the highest frequencies in our survey was performed. The factor model created this way allows us to identify higher-level dimensions which can be interpreted as a "fundamental intentions." The results of the factor analysis can be found in Figure 1. Here, the respective highest loadings of indicators have been attributed to one of the three latent variables ("basic intentions").

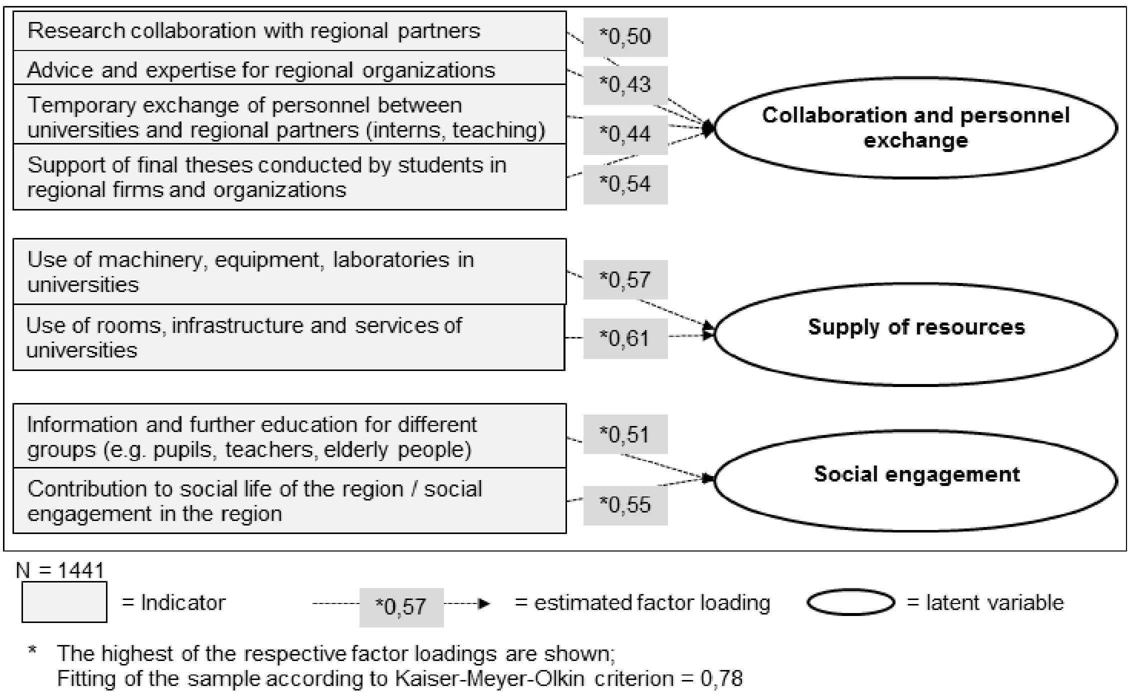

Figure 1: Factor analysis of forms of regional engagement
(Source: Koschatzky et al. (2013) based on own data collection)

It can be seen that collaboration and personnel exchange, the supply of resources, and social engagement as latent variables show the highest factor loadings. The first latent variable reflects the bilateral exchange of formal and professionalized forms of cooperation and the exchange by "transfer of heads", especially in the field of education and teaching. More professional and formal forms of cooperation seem to go along with an exchange "over heads", which both applies for more long-term oriented research collaborations and for short-term service-oriented activities. Both formal research collaborations and consulting activities as well as the exchange of human capital via students, graduates and business people can be interpreted as different forms of the use of existing informal relationships and thus be linked to individual trajectories. Spatial and cultural proximity is an important ingredient in their development (cf. Broekel and Binder, 2007; Perkmann and Walsh, 2009).

Another latent dimension is the provision of resources which is characterized by high loadings of the variables "provision of university's resources" and "provision of university's services." This dimension can be interpreted in spite of its specific character as an ingredient or origin of emerging relationships between academics and regional actors in the sense of the first dimension. One possible cause that in the context of the factor analysis this separate dimension was created is that in contrast to the first dimension these forms of regional activities can not be fully carried out in self-responsibility of the professor. The "provision of resources" requires in many cases a consultation with the faculty and university administration or internal approval processes that can not be decided solely on the level of a single chair or institute.

With regard to collaboration and the supply of resources the management of universities often make these highly visible and strategically important activities as activities at their own affair and invest substantial resources in the acquisition and the following implementation of projects and initiatives. In the view of university administrations it can be summarized that there are significant potentials of the strategic use of regional activities and that in turn universities as part of their "third role" (Gunasekara, 2004) may be an important driving force of al development.

One kind of this strategic use of regional activities is the engagement in new forms of strategic research collaboration with industry. As the already mentioned study from 2005/2006 showed, these new partnerships and forms of local or regional engagement were becoming an important activity since the mid 2000s (Koschatzky et al., 2008). The ResearchCampus programme is an example for the publicly financed stimulation of this kind of local/regional collaboration.

4 The ResearchCampus programme

The ResearchCampus programme (RCP) initiated by the Federal Ministry of Education and Research (BMBF) in 2012 is the most recent and certainly one of the most ambitious initiatives by the federal government affecting the regional engagement of universities in Germany. The RCP is built on a continuum of national measures which are implemented on a sub-national or regional level, although national objectives are pursued. Thus, the RCP and also the leading-edge cluster competition as another recent federal initiative are per se not focussing on regional development, but on activating regional research and technological potentials to achieve a superior goal. What makes the RCP so unique and at the same time so ambitious is that it goes far beyond of what similar interventions until now have been intended in terms of strategic, long-term private-public research partnerships which are institutionally and organisationally embedded in a certain region. Thus, with the RCP the federal government realizes a new instrument to initiate and strengthen co-operations related to research and innovation. One of the basic assumptions of this particular approach is the observation that medium- to long-term research co-operations at the interface between science and business to unlock, bundle and exploit research results are becoming more and more important regarding the capability of Germany as an innovation location (BMBF, 2011).

The ResearchCampus (RC) features a combination of three distinct characteristics:

› Proximity – the bundling of research activities and competencies at one location, as possible on a university or public research campus,

› The medium- to long-term adaptation of a specific research topic, ideally in the frame of a research programme,

› A mandatory public-private partnership.

The RC integrates a critical mass from science and business regarding research in a future-oriented subject. From the business sector, several companies are engaged in the RC, ideally SMEs. However, it turned out that large (multinational) companies are mainly the drivers within the RC. From the science sector, one or several universities habe to be involved. Furthermore, one or more non-university research centres should be engaged. Currently, ten different RC, which have been selected in the course of a competition, are operating. Each selected RC will be funded by 1-2 million Euro per year over a total period of up to 15 years. Thus, one RC with an average retention period of 10 years can receive up to 20 million Euro funds for common research activities. In addition, the business companies and other partners which are involved in the RC will supply significant own contributions, at least at the same amount as public funding. The following table indicates the ten RC currently operating. regarding their subjects, the RC are primarily active in the frame of "grand challenges", like energy, automobiles/mobility and health/medicine.

Apart from the considerable public budgets and the different topics addressing societal and technological challenges, the universities engaged in the RC (or which applied for funding), appraise the new programme as an opportunity to strengthen their specific profiles and at the same time achieve a certain degree of attention and reputation in the region and beyond. The latter aspect is pretty much in line with the purpose of many universities to increase their regional engagement vis-à-vis other research institutes and universities within the region and regarding the business sector. However, a federal initiative like the RCP and its different RC should not be mixed up with a “closed-shop” exclusively belonging to a few companies and universities, rather than sort of pilot models for other universities and companies to imitate successful RC. Furthermore, the RC should also not be mixed up with an approach that – due to its regional focus – prevents internationalization of science, research and technologies, but as a measure that strengthens pre-competitive, long-lasting research in very specific fields for the involved partners.

Campus	**Subject**	**Location**
ARENA 2036 – Active Research Environment for the Next Generation of Automobiles	Support of sustainable future mobility and production; multi-functional composite materials	Stuttgart
Connected Technologies	Overall subject: Smart homes and networked living of tomorrow; development of a basis for technologies, modes of interaction and business models for new application scenarios in the home environment.	Berlin
Digital Photonic Production	Laser application in production and construction of composites related to future areas like mobility, energy, health and ICT.	Aachen
Electrical Nets of the Future	Environment friendly sustainable energy technologies; research on direct current voltage for power transmission.	Aachen
Sustainable Energy- and Mobility development through coupling of intelligent nets and e-mobility	Integrated research on e-mobility by coupling energy technology approaches with mobility- and urban concepts.	Berlin
INFECTOGNOSTICS	Development of a technology portfolio which enables a highly-efficient and rapid on site proof of infection agents and microbiological contaminations.	Jena
Mannheim Molecular Intervention Environment – M2OLIE	Long-lasting research strategy with the aim to develop a molecular medical intervention environment regarding cancer therapy.	Mannheim
Mathematical Optimization and Data Analysis Laboratory – MODAL AG	Research on data based modelling, simulation and optimization of complex processes in logistics and medical technology. Main objective: optimization of nets, systems and related processes for instance regarding rail traffic, petroleum gasoline maintenance or medical diagnostic technologies.	Berlin
Open Hybrid LabFactory	Research focus on hybrid light construction; development of new process technologies aiming at the construction of innovative large-scale and functional light construction components.	Wolfsburg
STIMULATE – Solution Centre for Image Guided Local Therapies	RC develops and optimizes technologies for the screening of minimal-invasive methods in medicine; the focus is on important widespread diseases in the fields of oncology, neurology and cardiovascular diseases.	Magdeburg

Table 2: Overview of the research campus models (Source: www.bmbf.de)

A new programme like the RCP confronts both universities and companies with completely new requirements – structural, organizational and related to human resources. In this respect the key question is, which pre-conditions have to be fulfilled on both sides, which structures are appropriate, and which obstacles have to be overcome. The current observations of the ten RC point to quite different approaches, for instance regarding the contractual modes (e.g. IPR regimes) or the organizational models which have been chosen. As most of the involved partners cannot rely on long-lasting experience with the handling of such complex multi-functional networks, the current early phase of the RC implementation is characterized by trying out different approaches and modes and the necessity to learn from each other.

Regarding the pre-conditions at the universities engaged in the RC, it can observed that all of them are in a way “entrepreneurial” in their self-conception.[2] In this respect, long-lasting experience with cooperative research, be it in the form of contract or joint research, and sometimes close contacts to major companies within their regions, are often existent. The latter aspect is in a way crucial, as most of the companies being engaged in the different RC are large and technology oriented companies playing a significant role in the respective regional and also national innovation system[3]. In line with these kinds of experience or as a significant pre-condition, knowledge on the arrangement of intellectual property rights (IPR) can be regarded as a key to the successful implementation of the RCP. As the management of IPR is certainly one of the central topics of the RCP, existing experience and knowledge within the university appears to be quite crucial. Above all, the overall research strategy of the university administration (president, chancellor) as well as the entrepreneurial management of business-related activities can be identified as the driving force of the RC involvement of a university. A part of these management and governance competencies are for instance agenda-setting and moderation of regional engagement related activities.

Only a few involved universities can rely on experience made with the establishment of organizational modes regarding public-private-partnerships. In contrast to countries like the USA or Great Britain, these kind of models are a relatively new phenomenon for German universities. Several universities in Germany – even prior to the RCP - have established PPPs, but only rarely in such a comprehensive approach. In consequence, the RC are currently experiencing with different organizational models with the aim to identify the most adequate one. Against the background that each RC is operating under slightly different framework conditions – for instance in terms of the companies and university institutes involved, or the concrete RC topic – it remains to be seen which concrete models will be established and which reasons are decisive.

[2] As already pointed out in section 2, these observations are based on early findings of the ongoing the evaluation of the ResearchCampus programme carried out by the authors of this paper together with colleagues at Fraunhofer ISI and VDI/VDE-IT GmbH in Berlin.

[3] The role of large companies within the German federal innovation and research policy will not be deepened in this paper, but it can be confirmed that the federal government is very much reliant on these companies to achieve certain national goals, particularly related to the grad challenges which are accentuated in the RCP.

5 Conclusions and recommendations

In addition to flexible, project-based research partnerships between universities and firms in the regional environment increasingly more long-term institutionalized partnerships with regional partners like those under the umbrella of the ResearchCampus programme can be observed. Their objective is to pursue a common research agenda in a longer term perspective. Such partnerships are often multilateral, as they not ly include research organizations, but integrate different regional actors from politics, industry and society. Apart from research, often additional objectives are pursued, for example the profile and image building of the university and the region. This hybridization will increase and in future include other aspects such as the creation of attractive career opportunities in times of decreasing numbers of students (demographic change effects). Due to the growing demands that are addressed to universities, such multilateral and multi-functional networks are beneficial in several ways – not only for the universities, but for all partners. From the perspective of the university many not directly research or teaching-related tasks can be managed in a division of labour. In addition, the exchange and mobility in heterogeneous networks offer the opportunity to achieve innovative results in knowledge production and knowledge exploitation - as long as the autonomy of the university in teaching and research is maintained.

Agenda-setting and moderation are the major starting points of the university administration (presidents, chancellors) to influence the strategic use of regional engagement activities. A central coordination of the manifold activities within a university is neither administratively feasible nor a desirable university policy. Instead, in terms of corporate planning it can be recommended that university administrations should ensure that the potential contribution of regional engagement with respect to the achievement of the main university objectives in teaching and research will be developed comprehensively. Visions for positioning the university as an innovative and attractive research location using the diverse potentials of regional engagement are helpful. A particular strength of the management level is derived from its ability to stimulate cross-faculty initiatives and to bring existing activities together in order to promote and institutionalize these activities at the university level, but without preventing own activities at the faculty level. In this way, motivated professors and other university staff members can be gathered behind a common objective and additional innovation potentials be lifted. University administrators benefit most from regional-based potentials if they manage to overcome existing institutional rigidities and allow the formation of new collaborations and strategic alliances.

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Creating A Proof-Of-Concept Center At The University Of Akron: A Practical Guide For Translating Experiences Into Learning

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Abstract
Universities throughout the world are struggling to accept and implement world-recognized best practices for commercialization of university technology and transfer of university knowledge into for-profit organizations.

The objectives of this paper and presentation are to help universities throughout the world understand the value of creating and supporting a proof-of-concept centre within the university infrastructure. The University of Akron and its Research Foundation have been undertaking this effort for the last two years and will share our experiences with others.

The University of Akron (UA) and its Research Foundation have been engaged in technology commercialization, innovation and entrepreneurship support for over a decade and have successfully integrated with the regional ecosystem to support technology based start-up companies in the region. As a result of this partnering, a culture change has begun in the greater Akron community that is centred around UA, such that entrepreneurship and innovation are very strongly engrained in the basic fibres of economic development and job creation in the community. The recognition that the University of Akron Research Foundation (UARF) received in partnership with the Austen BioInnovation Institute in Akron from the U.S. Economic Development Administration I6 Innovation Award in 2010 is but one example of this transformation to an innovation and entrepreneurship centred university and community model, the "Akron Model."

The University of Akron Innovation Practice Center (IPC) is focusing its efforts on the well-recognized strengths of UA in areas such as advanced materials, polymer technology, biomedical technology, clean tech, renewable energy, corrosion engineering, and sensors by aligning these strengths with the industry-based core competencies in the region. The IPC is focuses on commercializing high-growth-potential technologies through start-up company creation and licensing, while advancing entrepreneurship in the region through education, internships, and outreach programs.

The primary goal of the IPC is to create high "impact" economic development with high paying jobs through technological innovation and start-up company commercialization. This moves technologies at UA and within the greater Akron community from the laboratory to the market place faster. As a second goal, the IPC provides educational experiences to UA faculty, students, and the local Akron community in technology commercialization, entrepreneurship, and new business development through hands-on mentoring and training programs.

The main purpose of this presentation and paper is to share our knowledge and experience with universities around the world.

Keywords
Proof-of-Concept, Commercialization, Technology Development, Patents, Entrepreneurship, Start-ups, Validation

1 Introduction & background

High impact technologies, particularly those coming from institutions of higher education, often lack sufficient technology validation funding, which allow researchers to produce proof-of-concept products and market-based business models with entrepreneurial support.

The University of Akron Innovation Practice Center (IPC) provides a systematic, scalable model for accelerating technology based economic development, educating and attracting students and experienced entrepreneurs, and creating high paying jobs. The IPC solution is helping to bridge the innovation gap between universities and industry to increase high quality deal flow from university research and create more companies with strong entrepreneurial leadership by applying best practice elements present in the Ohio ecosystem.

The items discussed within this paper are general enough to apply to any region in any country and any university grappling with the issues of “How can we accelerate commercialization efforts around our technologies?” For clarity, there are often references to our “region,” “state,” “University,” or “ecosystem.” While these references are specific to the Northeast Ohio area, it should be easy for the reader to translate these references into something meaningful in the readers local.

Contained in this paper is a scalable model that can be created by integrating a best-in-class Deshpande-like proof-of-concept centre (Kauffman, 2008) with recognized best practices of The University of Akron (UA) evidenced in the “Akron Model” for university-community engagement, including expertise and models for intellectual property management and technology commercialization developed at the University of Akron Research Foundation (UARF).

The UA IPC is using existing scalable best practices and applying them in the pre-company innovation space to bridge the innovation gap. Over the next 10 years, IPC envisions the development of over 60 start-up companies based on technologies developed at regional research universities, leading to a creation of more than 2,400 jobs.

2 The University of Akron Innovation Practice Center

In June 2011, UARF began discussions and collaboration with The Deshpande Foundation to create a Deshpande-like proof-of-concept center in our region. As discussions progressed, it was clear that there is an easliy scalable model that can function in any region. This model is easily modifiable to account for regional strengths and available resources.

2.1 Five Key Building Block For the Innovation Practice Center

In short, the IPC is a regional technology translational hub led by a fully dedicated **Executive Director** with the inclusion of a new **Grant Program**, expansion of the mentoring efforts of existing regional collaborators (**Catalysts**), expansion of the Akron Regional Change Angels (ARCHAngels) Investment Network (**Events**), and the implementation of **Innovation Teams**. Each of these is discussed in more detail below.

Executive Director: The IPC w is led by a highly qualified **Executive Director** that oversees **Catalysts** enlisted from the entrepreneurial and business community, training and recruiting students that drive **Innovation Teams**, soliciting and vetting technology project proposals for IPC grant funding, leading educational efforts for both students and faculty researchers tied to successful technology projects, and organizing networking events for the entrepreneurial community. The **Executive Director** is supported by existing resources from the community, including accounting, grant administration, legal and business expertise, and intellectual property support. These resources come from the local universities and business organizations.

Grant Program: The IPC **Grant Program** provides funds to facilitate translational research and prototyping for high impact technologies. IPC solicits applications two times each year, awarding grants of up to $25,000. A **Grant Program** Committee reviews applications, basing its selections on:

(1) intellectual property protection (including strength of patent, scope of protection [generic v. Specific], and remaining patent life),

(2) technology (including degree of advancement over market, time and resources needed to validate, and complexity and cost of manufacturing),

(3) market forces (including speed of progress in industry (obsolete), competing patents and technologies, size of current and potential market, and market trends), and

(4) business factors (including lead ership team, fit with the regions strengths, and connection to potential licensees).

Upon completion of the review process, the Committee invites up to 12 applicants to interact with **Catalysts** and form **Innovation Teams**, that help guide the creation of a detailed project plan. At this point in the program, no money has been awarded. The applicants then submit a six page detailed proposal to the Committee, which awards grants to the best technology projects to complete the proposed testing, analysis and prototyping.

Catalysts: **Catalysts** are experienced industry entrepreneurs that work on a *pro-bono* basis. Prior to funding under the **Grant Program**, applicants work with an assigned **Catalyst** and **Innovation Team** to conduct preliminary market and intellectual property research, as well as preliminary business model development to establish viable, achievable milestones with the proposed grant money. Once an applicant is selected through the **Grant Program**, its **Catalyst** and **Innovations Team** become closely involved to direct the technology through the challenges associated with developing proof-of-concept. **Catalysts** and **Innovation Team** members are permitted to join the resulting start-up, providing continuity and encouraging continued innovation. As **Catalysts** and **Innovation Team** members move through the system and into new spin-out companies, the **Executive Director** recruits additional **Catalysts** and **Innovation Teams** to fill the void

Innovation Teams: **Innovation Teams** are largely comprised of students from local universities to provide experience working for entrepreneurial ventures and offer potential job opportunities. Before joining the **Innovation Teams**, team members participate in a Technology Commercialization Course, taught by UARF entrepreneurial personnel associated with the IPC. This course covers major components of commercialization, including intellectual property assessment, market research, technology valuation, profiling competitors, entrepreneurial finance and business model drafting. The **Executive Director** selects top course participants to join the **Innovation Teams**.

Events: The **Executive Director** uses outreach and recruiting open houses, held at venues throughout the region, to help identify, develop, attract, and mentor potential entrepreneurial talent. **Events** are held on a quarterly basis to bring entrepreneurs, investors, students, and commercially investable companies together to network and build relationships. These workshops provide an opportunity for IPC technologies to present prototypes, products, and testing results to a focused group of investors and entrepreneurs. Once a year, the **Executive Director** organizes a Showcase Symposium where investors from across the country are invited to hear a presentation from each of the IPC funded technologies. As an elite, invitation only event, this meeting gives angel investors and venture capitalist a first look at IPC technologies and provide feedback to presenters.

2.2 Leadership is Critical

Innovation is driven by strong leaders, who create the culture, define the vision, develop high-level strategy, and ensure that their goals are pursued collaboratively and inclusively across their institutions and region. UA is fortunate to have outstanding leaders, whose shared vision and strategy can be implemented in a coordinated, scalable fashion across the region and replicated throughout the nation.

UA President Luis Proenza is nationally recognized for leading research universities to improve regional economic development. He has led UA's transformation into a powerful engine for regional economic development, a catalyst for collaborative initiatives, and the preeminent public university in the region. Under his leadership, UA has financed $625-million in capital construction to completely transform its campus, adding 20 new facilities, 18 major renovations and additions and 34 acres of new green space, thereby becoming one of the most attractive metropolitan campuses in the nation. Dr. Proenza also led community efforts to create two key enterprises: a University Park Alliance that is revitalizing a 50-block area surrounding its campus, and the $200-million Austen BioInnovation Institute in Akron, a partnership with three area hospitals and a medical school to establish Akron as a center for biomaterials and biomedicine.

Dr. Proenza is supported by Provost Dr. William M. "Mike" Sherman as UA's senior vice president, provost and chief operating officer. Sherman, as the senior academic administrator, leads the academic, research and service components of the University. He also oversees operations, working to align UA's academic support units to enable the university's academic agenda carried out by faculty – with the ultimate goal of promoting student success.

UA is supported by UARF, a seperate 501(c)(3) organization dedicated to the succes of UA. UARF is the commercialization arm of UA. Dr. George R. Newkome is the President and chief executive officer of UARF. Dr. Newkome also serves as the Vice President for Research and Dean of the Graduate School at UA. With a focus on commercialization, Dr. Newkome is on the board of directors for 14 corporations as well as numerous editorial boards.

Together, the critical UA leadership team has embraces the Akron Model for regional impact and increased research expenditures by 60 percent in the past decade.

3 Resources, ecosystem, & partnerships

The IPC is built upon partnerships that integrates the strengths of UA and other research universities with the commercialization and entrepreneurial experience of UARF. An example of some of the other regional organizations that strengthen the IPC are relationships with Lorain County Community College (LCCC) with its nationally-recognized Innovation Fund, outstanding Great Lakes Innovation and Development Enterprise (GLIDE) mentorship and incubator programs, and focus on entrepreneurial opportunities for students, and JumpStart's entrepreneurial talent recruitment network and rigorous program of experienced mentorship.

With these key resources, the IPC has created a Deshpande-like proof-of-concept center built on existing, scalable, best practices from the region. In particular, the following best practices are leveraged:

› UA's Akron Model,

- UARF’s technology commercialization excellence,
- LCCC’s early-stage investment and entrepreneurship model, and
- JumpStart’s mentorship and talent recruitment programs.

3.1 Key strengths of the University of Akron and other regional universities

The Akron Model, where research universities provide leadership and use their “tool chests” to strengthen regional economic development (see **Figure 1**), was recognized as a best practice for research universities in a recent Ohio Board of Regents report (Regents, 2012). UA is in full support of The Akron Model which includes a new ten-year strategic investment plan that calls for bold initiatives and significant growth, including making a $1 billion investment over 10 years in student programs, faculty, research, campus and community while increasing annual research expenditures by 75 percent. As it relates to the IPC, the Akron Model provides strong framework for faculty and student innovation and entrepreneurship.

<u>Innovative Research</u>: Over the past decade, UA has increased its research budget by 60 percent and invention disclosures by 300 percent with more than 80 new inventions disclosed each year by UA faculty. This increase, which will provide one source of high quality deal flow to IPC, results from a university culture that values technology commercialization. UA is home to the nation’s fourth fastest-growing engineering program, one of the nation’s largest doctoral chemistry programs, and a College of Polymer Science and Polymer Engineering that consistently ranks among the top polymer programs in the world. Building on this strength, UA has developed nationally distinctive programs such as the Advanced Functional Materials Center with dozens of industry partners, the nation’s first undergraduate program in corrosion engineering, and a collaboration with the Ohio Agriculture Research and Development Center, the largest university agricultural bioscience research center in the nation. In addition to 115 active industry research projects, UA formed a shared surface engineering laboratory with global bearings manufacturer The Timken Company, which has become a scalable model for university-industry strategic partnership (Timken, 2011). UA is also a founding member of the Austen BioInnovation Institute in Akron (ABIA) in collaboration with three Akron hospitals and an independent medical school.

Figure 1*: The Akron Model and the University of Akron "Tool Chest."*

Student Engagement in Innovation: UA focuses on giving all of its students practical industry experience through such programs as the undergraduate co-op initiative to place students with local industry and the Industrial Assistantship Program that pays graduate stipends for students who spend their time with an industry partner. Building on UA's strong engineering program and the Fitzgerald Institute for Entrepreneurial Studies, Akron Innovation through Convergence and Entrepreneurship Program creates UA technology based start-up companies by pairing core teams of engineering and science graduate students with medical residents, business students, intellectual property law students and faculty mentors to pursue research projects over three- to four-year periods. Successful UA student led companies have been rewarded with business competition prizes ranging from $10,000 to $100,000.

3.2 Key strengths of the University of Akron Research Foundation

UARF, an independent nonprofit that supports the technology commercialization activities of UA, combines the expertise of industry leaders, intellectual property attorneys, business experts, scientists and entrepreneurs. UARF presents a best practice scalable model for intellectual property management and entrepreneurial support services that help technologies transition to the marketplace.

Intellectual Property Management: UARF's technology transfer successes, including ranking #1 in the world in patents issued per million research dollars in a Milken Institute study (Milken, 2006), stem from leadership that sees the potential in supporting technology commercialization, collaborative relationships with faculty, and a sincere understanding of licensees' corporate culture that results from an Office of Technology Transfer staff with more than 100 years of collective industry experience. UARF has assisted in the creation of more than 50 start-up companies in the past decade.

Commercialization Support: To help assist UARF in the commercializaion efforts are seven full-time *pro-bono* Project Executives, former industry leaders tasked with forging regional industrial partnerships, leading to a network of hundreds of area small and mid-size businesses. These Project Executives help form the ARCHAngels Investment Network, which brings together angel investors and promising technology companies that leverage the region's strengths in health care, renewable energy, information technology, polymers and advanced materials. Since 2005, ARCHAngels presenters have attracted more than $175 million in follow-on funding, as well as in-kind legal, accounting and mentorship from an engaged group of over 550 ARCHAngels members. ARCHAngels provide entrepreneurial education experiences for regional university students and was instrumental in forming the Northeast Ohio Student Venture Fund, which provides students with the experience of performing due diligence on early stage technology companies in a mentored atmosphere.

3.3 Key strengths of partner organizations

LCCC is a close collaborator with UA and UARF. LCCC President Roy Church provides a leadership vision of educational institutions as drivers of economic development. LCCC was the first college in the state to build an advanced technologies center for business and industry and leads such initiatives as the Innovation Fund, student entrepreneurship engagement, and GLIDE– all of which compliment the UA IPC.

JumpStart maintains a nationally recognized model for accelerating the success of entrepreneurs to benefit the regional economy. JumpStart's team of experienced entrepreneurs invests directly in companies, provides intensive assistance to the regions high potential companies through one-on-one mentoring, and partners with regional leaders to strengthen the entrepreneurial ecosystem. JumpStart has helped 121 companies raise $470 million in risk capital, generated $220 million in regional economic benefit, and directly created or retained 2,581 jobs. Recognized as a best practice, JumpStart America, part of President Obama's Startup America Partnership, brings the JumpStart model to regions with high growth potential by bringing together regional stakeholders to develop community-specific implementation plans (JumpStart, 2012).

Leadership is critical and LCCC President Roy Church has re-focused LCCC's mission on regional wealth creation, crafting dynamic educational opportunities and improving access to higher education. During his 15-year tenure at LCCC, Dr. Church and his team have led nationally recognized efforts, such as the Innovation Fund and the University Innovation Partnership with UA and UARF. While LCCC provides significant student and educational focus, JumpStart adds specialized entreprenuerial support. The strong leadership and support of JumpStart President John Dearborn helps provides leadership for the regions start-up companies through improved access to capital, strong mentorship and entrepreneurial talent development. This combination of leadership and proven innovation and entrepreneurial systems forms a powerful regional ecosystem when leveraged, coordinated and expanded with the IPC.

Lorain County Innovation Fund: Pairing the earliest stage of pre-seed funding in the region with a requirement that all funded companies create at least one student internship, the Innovation Fund's vision is to inspire and educate students in entrepreneurship, so that students will create their own regionally "sticky" jobs with new companies that will remain in the area. Since 2007, the Innovation Fund has connected 150 students with internships, invested $6.4 million in 94 early stage technology companies, leading to over $62 million in follow-on funding (Innovation Fund, 2013). Innovation Fund companies have created 167 jobs with an average salary of $57,000. As a national best practice, in 2012, the Kauffman Foundation announced Innovation Fund America, a $1 million project to scale LCCC's Innovation Fund in three pilot communities across the country (Kauffman, 2012).

LCCC Student Engagement in Entrepreneurship: LCCC awards associates degrees in a wide range of scientific, engineering and business fields. Nationally, LCCC is recognized for model programs in entrepreneurship and recieved funding from the Kauffman Foundation to make community colleges a "front door" for entrepreneurship and was one of four Ohio colleges chosen to participate in a three-year $3.2 million partnership with the Blackstone Charitable Foundation and Burton D. Morgan foundation to train the next generation of entrepreneurial students and alumni.

Great Lakes Innovation and Development Enterprise: The GLIDE Accelerator, created in 2001 by a partnership between LCCC, the Lorain County Chamber of Commerce and the Lorain County Commissioners, has assisted over 2,600 entrepreneurs and businesses, that have created over 700 jobs, and helped portfolio companies capture over $60 million in revenues. Over 90 percent of the GLIDE supported client companies are still in business today.

JumpStart Regional Network of Entrepreneurial Talent: JumpStart's Entrepreneurial Talent Recruiting Program takes a disciplined approach to pairing C-level talent (e.g., CEO, CFO, CMO) with high growth start-up companies based on the background and skills of the talent and the needs of the company. JumpStart helps the IPC with these same services on an as needed basis by pairing inventors and innovators with appropriate business teams to turn inventions into commercial products and assisting in attracting and retaining entrepreneurial talent in the region. JumpStart represents a large number of practicing entrepreneurs from portfolio companies, who provide mentorship and internship experience to interested students from more than 20 regional universities.

Leadership Training and Business Preparation: The JumpStart Mentoring Program, modeled after Massachusetts Institute of Technology's successful Venture Mentoring

Service, connects local early stage start-ups with mentors ranging from presidents of Fortune 500 companies to Venture Capitalists to leaders of celebrated tech start-ups. JumpStart supports the mentoring talent to the **Catalyst** program, designing effective support systems for IPC talent, and leading crucial data collection to assess and improve results.

4 Sustainability

The IPC has recieved support from UA to help defray the start-up costs associated with the project. Additionally, UA has committed significant hiring and personnel support that to allow for several full-time faculty/staff to suppor the project indefinitely. While the critical personnel are covered by UA, the remainder of the costs (e.g., **Events**, **Grants**, etc.) need to be supported by outside funding sources. UA has specifically comitted to "discoveries that will increase external funding, patents awarded, as well as licensing and commercial successes that will be facilitated by the university-wide proof of concept strategy" (University of Akron, 2012).

Other State and Federal grants are used help augnment the costs associated with specific elements of the IPC. Specifically, the IPC has recieved support from the Ohio Third Frontier Entreprenuerial Support Network Fund, the Ohio Third Frontier Pre-Seed Fund, and National Science Foundation I-Corps Sites Program. Further funding is being pursued through the Ohio Board of Regents Technology Commercialization Program. Depending on successes of a specific technology, one of the main outcomes of IPC is to sufficiently support and prepare technologies and subsequent start-up companies to submit applications for follow-on funding through the:

› National Science Foundation I-Corps Teams Program,
› Federal Agency SBIR/STTR Programs,
› Ohio Third Frontier Technology Validation and Startup Fund, and
› National Collegiate Inventor and Innovator Alliance E-Team Program

While State and Federal grant programs are useful, these programs are often not a good fit for long term sustainability. As such, the IPC is always actively pursuing other philanthropic corporate and sponsorship opportunities that are focused on supporting the region's long-term economic wellbeing. UA has already been apporached by multiple regional organizations and community leaders that wish to do more than invest in individual companies and technologies and see the value of supporting an effort that helps seed dozens of nascent technology projects over the next five years. Additional fundraising is currently under the direction of the Executive Director, who works closesly with UA's Office of Developmnent to attract private and industrial donations and increased alumni and foundation support.

5 Conclusions and recommendations

In conclusion, it is necessary for the reader to understand this is a long-term process and it will likely take several years to implement. For the best results in a specific region, it is critical to understand the existing infrastructure that is available. In helping determine the starting point for any region, it is helpful to ask the following questions:

› What Universities are located in the region in questions?

› What economic development organizations are in the region?

› Who are the primary leaders in the region that will support these initiatives?

› What industries are in the region? Are there certain areas of expertise that can be tapped into (e.g., biomedical, manufacturing, specialty materials, etc.)?

› Of the industries in the region, are there some that are much more technology based?

› What networks are available to help link efforts together across the region?

› Are there large gaps of recourses that need to be filled in before the creation of a proof-of-concept initiative?

› How are we going to make this effort sustainable?

Other questions more focused on a particular region may be helpful as well.

Of highest importance to the recent best practice proof-of-concept centres is the capability to become sustainable. If there is not a clear path to sustainability, then there needs to be a significant focus on how to become sustainable.

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Going Beyond Category Performance: Creating Brand Equity By Managing Corporate Identity

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Abstract

An organization's true value stems from its brand values rather than its category values. This is one of the central assumptions of identity marketing, a management paradigm which states that organizations will only be of significant value to customers, employees and society if they act on the basis of their core values.

In order to be able to create maximum brand equity, an organization needs to be able to: (1) turn its abstract corporate philosophy (identity) into a limited set of concrete manageable behaviours, attitudes and processes; and (2) measure its performance levels regarding both category and brand values. Most organizations only measure their category performance and thus are unable to create maximum brand equity.

In this paper we present an ongoing joint research project of Saxion and Zorggroep Sint Maarten, a middle-large organization with seventeen rest and nursing homes throughout the Netherlands. Together, we developed the Identity Management Dashboard (IMD), the result of a combined approach of action research and measurement tool development. The purpose of the IMD was to enable ZSM to create maximum long term brand equity by meeting the requirements 1 and 2 mentioned above.

To our knowledge, our identity management dashboard is the first of its kind. It offers great opportunities to all organizations that wish to go beyond management of category performance and manage brand performance in an active, day-to-day, hands-on way. The paper describes the origination and development of the IMD as well as the initial responses it evoked. The paper further tells how ZSM started implementing the IMD in the organization. It concludes with lessons learned so far in this on-going process of co-creating increasingly significant brand equity.

Keywords

Brand Equity, Corporate Identity, Identity Management, Innovation

1 How it all started: just caring is not enough

Adequate functioning in terms of meeting the category standards of your business is no longer sufficient to achieve long-term customer loyalty. In health care, for example, providing good and reliable care is necessary but not sufficient (Woldendorp, 2010). Naturally, if you fail to perform, you will quickly lose clients in today's transparent market. If you do perform well, people will shrug and wonder what your added value is.

An organization's true value stems from its brand values rather than its category values (Kotler, Kartajaya & Setiawan, 2010). This is one of the central assumptions of identity marketing, a management paradigm which states that organizations will only be of significant value to customers, employees and society if they act on the basis of their core values (Morel, 2010). Let us return to our health care example. If an organization works according to the principles of identity marketing, it would reason as follows: "Providing good care does not do the job for us. We want people from zero to a hundred years of age to be able to share their lives with each other. We cannot accept people becoming socially isolated through locking them up in nursing homes. Instead, we want people to be part of and take part in society in every possible way."

The aforementioned philosophy is exactly the line of reasoning of Zorggroep Sint Maarten (ZSM), a middle-large organization with seventeen rest and nursing homes throughout the Netherlands. They recently received the triple A status in a Dutch benchmark research. This tells us how well its category performance is. Naturally, ZSM was content with this result, but they did not wish to stop there. To them, providing top-quality care is important. But actively enabling people to share their lives with each other, in other words delivering their brand value, is equally important and perhaps even more fulfilling to them.

The desire of ZSM to increase their significance for the elderly that are entrusted to their care had lead to the start of an identity marketing process about three years earlier. The purpose of identity marketing was to further focus and bundle the spirit and strength of (the people working in) their organization. Key questions that were addressed are: what binds us together?, what are we really good at?, what makes us different from others?, and what do we want to mean to whom? These questions play a role at the corporate level as well as at the level of individual homes. ZSM decided to first determine their corporate identity with the involvement of all of the homes. Then, within the framework of the corporate identity, each home got the task to develop their own individual identity from which they were going to contribute to the corporate identity. This two-stage process led to the corporate identity indicated with the phrase *Share your life* and to a set of eventually seventeen subordinate identities for each home that were captured by phrases as *The art of living*, *The time of your life*, *Neighbours in the city*, and *Sincere Friendship*. At the time the current research started, the corporate identity had been determined and adopted by all homes, and several of them had just determined their own identity or were in the middle of doing so. This was the moment for central management to start monitoring the overall progress of the (corporate) identity marketing process and its effects on ZSM's brand equity.

In order to be able to create maximum brand equity, ZSM needed to be able to: (1) turn their abstract corporate philosophy (identity) into a limited set of concrete manageable behaviours, attitudes and processes; and (2) measure their performance levels regarding both category (*Good care*) and brand values (*Share your life*). To this end, Saxion in close cooperation with ZSM developed the Identity Management Dashboard (IMD), the result of a combined approach of action research and measurement tool development. To our knowledge, our identity management dashboard is the first of its kind. It offers great opportunities to all organizations that wish to go beyond management of category performance and manage brand performance in an active, day-to-day, hands-on way. The paper describes the origination and development of the IMD as well as the initial responses it evoked. The paper further tells how ZSM started implementing the IMD in the organization. It concludes with lessons learned so far in this ongoing process of co-creating increasingly significant brand equity.

2 Main principles guiding the development of the IMD

A management dashboard "is a layered information delivery system that parcels out information, insights, and alerts to users on demand so they can measure, monitor, and manage business performance more efficiently" (Eckerson, 2011: 10). ZSM initiated the development of the IMD because it wants to be able to effectively manage both category and brand performance. Whereas management information regarding category performance has traditionally been abundantly available in the health care branch, the equivalent regarding brand performance is practically absent. In addition, the way management information is collected and reported (in large scale benchmark research) alienates the majority of employees of rest and nursing homes. As a result, they consider the process of data collection as time consuming and cumbersome and the results as largely irrelevant to their actual work. In short, current research on category performance is considered a waste of time and money by most people participating in it. Nevertheless, organizations participate because they are obliged to by legislation or branch regulations.

Being fully aware of the aforementioned perspective on performance research, we applied a functional design approach, meaning that the IMD is an interactive and flexible instrument that presents information in various formats and at various levels of aggregation (Yigitbasioglu & Velcu, 2012) depending on who is using it. Hence, we set out not only to develop a performance measurement instrument that would include the hitherto largely absent brand performance information, but to develop an instrument that would collect, monitor and report relevant performance information in a way that the intended users experience it as being:

- <u>Advantageous</u>: the IMD is important and useful for those who work with it;
- <u>Easy to use</u>: using the IMD is easy and quick and does not hinder primary activities of those who work with it;
- <u>Congruent</u>: the IMD fits the expectations and behavior of those who work with it.

Ever since the research on adoption and diffusion of innovation by Rogers (1995) and many others, we know that these three factors are the most important determinants of innovation acceptance. Additional requirements in this case were:

- Activating: the IMD incites development of the (people in the) organization by means of a process of action-evaluation-reaction. Moreover, it does so in a way that is supporting, reinforcing and pleasing to those who work with it;
- Smart and parsimonious: the IMD combines maximum effectiveness with minimum hassle for those who work with it;
- Integrated: the IMD is an integral system. No loose components that cannot be connected. Furthermore, the IMD includes current measurements as much as possible; it uses what is good and works.

3 Developing the IMD through co-creation

The first version of the IMD was created in one week in-company by the authors in close cooperation with the prospective users of the dashboard. This way the development could be both effective and efficient.

The IMD was developed according to the different stages as recommended by Eckerson (2011). First, the different internal stakeholders were identified. This is a crucial step within the development of the IMD, because a well-chosen group of internal stakeholders makes sure that the dashboard uses and visualizes the correct strategy, means and statistics (Eckerson, 2011). Next, a person from each group of stakeholders was interviewed to determine what information they needed as ingredients of the IMD. The results of these interviews were used to create a first concept of the IMD. The stakeholders were continuously asked to provide feedback during the development of the IMD. This feedback was used to further develop the IMD. Thus a continuous interaction between developers and stakeholders took place. At the end of the week the concept of the IMD was presented to all involved parties.

4 The IMD in a nutshell: simple, relevant and compatible

ZSM uses five different performance indicators that had to be integrated into the IMD. These five performance indicators are: (1) clients; (2) employees; (3) market and environment; (4) finances; (5) processes and management. The interviews revealed that the stakeholders requested three levels of information on each of the performance indicators (see Figure 1). The first level of information is based on research that can be executed within a couple of minutes and provides insight on the category- and brand performance on a weekly basis. The second level of information complements the first level of information. This level of information is based on research that can be executed (bi-

)monthly to monitor the effects of certain interventions or developments within the organization. Finally, the third level of information exists of trade related benchmark studies executed on a (bi-)yearly basis. Combined, these three types of research cover the whole spectrum of relevant management information in a cost-effective manner.

<table>
<tr><th></th><th>(1) Clients</th><th>(2) Employees</th><th>(3) Market & environment</th><th>(4) Finances</th><th>(5) Processes & management</th></tr>
<tr><td colspan="6">‘Weekly Following’
Monitor oriented
Category performance: “good care”
Brand performance: Share your life
Extremely simple, minimal size, takes seconds, feedback within a day
Internally motivated, highly relevant, compatible with daily practice/own working conditions</td></tr>
<tr><td colspan="6">‘Monthly In-depth’
Improvement oriented
(Partly) stems from ‘weekly following’
Hypothesis testing
Focused deployment of specific research modules on team, location or organizational level
Simple, reasonable size, takes minutes, feedback within a week
Internally motivated, highly relevant, compatible with daily practice/own working conditions</td></tr>
<tr><td colspan="6">‘Yearly Comparing’
Comparison oriented (benchmark)
Parallel to ‘weekly following’ and ‘monthly in-depth’
Complex, large size, takes hours, feedback within weeks or months
Externally motivated, relevant, less compatible with daily practice/own working conditions</td></tr>
</table>

Fig. 1:Overview of the Identity Management Dashboard created for Zorggroep Sint Maarten

The parts of the IMD that cover the performance indicators ‘Clients’ and ‘Employees’ are clarified for illustration purposes. To collect data for the first level of information (‘Weekly Following’) a simple and effective instrument was developed existing of two questions that can be asked both to the client and to the employee. The first question is “How happy are you with the care provided?”. This question is an indicator of category performance on a scale of 1 to 10. The second question is “To what extent have you been able to share your life this week?”; it is an indicator of brand performance on a scale of 1 to 10. These two simple questions thus form the indicators for category and brand performance. The indicators and their development can be monitored on a daily basis at different levels (i.e., team, location or organizational level).

The second level of information (‘Monthly In-depth’) is collected when needed. A possible reason for collecting data is a change in the brand and/or category performance indicators. As an example: the brand performance on *Share your life* on location ‘Autumn Wind’ shows a remarkable dip in a certain week. Location manager William registers the dip and asks his employees whether there is a particular reason for this dip. Employees mention three possible causes: (1) the number of visitors was particularly low during that week; (2) the collective music lesson with the local brass band ‘Humpa Pah’ was canceled due to illness; (3) the weather was bad which forced clients to stay inside. William wants to know the real reason and thus decides to start-up a small-scale digital study. The study is executed the same day and his employees collect data among their clients by simply asking the clients during their daily interaction why they feel they have been less able to share their live in that particular week. The content and set-up of the study is ready-made and available in the research database of the health care group.

Alice, an employee of the central office, assists the people from ‘Autumn Wind’ during the execution of the study. Only two days later Alice presents the results to William and all others interested. It appears that the collective music lessons are very important for the clients. A few weeks later, when the collective music lessons have restarted, the scores of brand performance are up to scratch again. The location has also started to seek contact with other associations within the community to be able to offer more collective lessons and activities as a result of this study.

Although the IMD was developed to be easy to use and compatible to daily practice, it represents a new way of thinking for ZSM on why and how to collect data and what can be achieved by acting upon the found results. Failing to grasp this new way of thinking may act as a barrier for acceptance of the IMD. The above illustration is a summarized example of a set of scenarios developed by the first two authors to explain the working of the IMD to its future users. This method was chosen, because studies show that creating a narrative or scenario of somebody using and interacting with a new product allows users to better imagine the benefits of that new product (Dahl & Hoeffler, 2004; Van den Hende & Schoormans, 2012), thus enhancing the likelihood of adoption.

The third level of information (‘Yearly Comparing’) is collected in a similar method to how it is carried out at this moment. Each year ZSM takes part in a trade related benchmark study in which the management processes and results of the organization are compared to those of other health care organizations. ZSM will continue to take part in this benchmark because information about the performance of the organization needs a solid context (Pauwels, et al., 2009).

5 The IMD in practice: incubation and implementation

5.1 Initial responses

The development process of the IMD resulted in the concept described in the previous section and a set of six scenarios depicting the use of the IMD by the different stakeholder groups. With the presentation of this concept to the involved employees of ZSM the project entered the stage of incubation. It is fair to say that the term incubation accurately described the period following the deliverance of the concept IMD. Initial responses to the concept were predominantly positive, but mixed. Some people were, understandably, overwhelmed by its comprehensiveness and needed time to let it sink in. Others, in particular two of the location managers, were highly positive exclaiming that this was exactly what they had been waiting for and needed to turn their abstract corporate philosophy (identity) into a limited set of concrete controllable behaviours, attitudes and processes. The employee working at the quality research department and as such likely to work extensively and intensively with the IMD, stated that the IMD made sense to her and that she felt comfortable working with it. The concern controller was struggling with the question of data validity: he expressed his trouble with visualizing what the results from the IMD would actually *be worth* to him and others: to what extent would the results be 'hard' and suitable to base major decisions on? The CEO, finally, emphasized the importance of the activating power of the IMD: it should stimulate and assist those working at ZSM to deliver the brand performance *Share your life* on a day to day basis. He further remarked that he was happy with the IMD because he noticed that the others, that is the prospective users, were happy with it. At the end of the presentation of the concept, the attendees agreed that they would study the IMD after which a meeting would be organized for both further clarification and continuation into the implementation stage.

5.2 Losing momentum

The concept IMD was presented in December 2011, just before the Christmas Holiday. The intended follow-up appointment never took place. The team responsible for the IMD development within ZSM, headed by the concern controller, informed us that there were no specific clarification questions, but that they were thinking about the best way to proceed with the implementation of the IMD.

Time passed and it was not until the end of June 2012 that a meeting was planned between the ZSM project team and the researchers to prepare for the implementation of the IMD. In retrospect, we believe that a combination of four factors was responsible for the breathing space of half a year.

First and most important, ZSM struggled with the way the identity marketing process was aligned. As explained earlier, it was organized such that first the corporate identity of ZSM was determined, resulting in the *Share your life* philosophy. Next, within the framework of the corporate identity, each of the seventeen nursing homes, developed its own (local) identity. The development of the IMD was organized accordingly. We first focused on measuring category and brand performance at the corporate level. The resulting IMD has already been described in the previous sections. We argued that once this corporate IMD would be up and running, it would then be relatively easy to gradually 'add' new modules for each home to include all local identities in the brand performance measurement. This dual approach, however, seems to have had a paralyzing effect on the organization. Central management, on the one hand, focused on getting the corporate IMD running first in order to get insight in the overall progress of the identity marketing process. Local managers, on the other hand, were first and foremost interested in developing and managing the identities of their own homes. To them, the corporate IMD was useful but left various issues unanswered at the same time. As a result, central management's first priority was the implementation of the IMD, whereas local management's priority was the development of their own IMD module. Put differently, part of the organization was 'ready to measure' whereas another part was still discussing the what and how of measurement. This 'controversy' definitely frustrated implementation of the IMD both on and underneath the surface.

Apart from alignment issues, cold feet also played a retardant role. Within health care institutions in general, and so as well within ZSM, performance measurement is a delicate issue for two main reasons. First of all, as noted before, there is little enthusiasm for performance measurement, because these measurements are perceived as tedious, largely irrelevant, waste-of-time-and-money, but mandatory exercises. Second, health care professionals seem to be suspicious of performance measurement because it is related to personal accountability, a phenomenon that is associated with commercial profit-driven organizations and not with the public institutions they are part of. This tendency is probably enhanced by the fact that health care professionals over the years have seen their organizations become more and more infected and affected by free market thinking, reducing their work to a set of depersonalized cost effective tasks rather than taking care of people. Within ZSM we noticed a certain hesitancy with respect to measuring identity-related performance, almost as if people were afraid that they would welcome the Trojan Horse.

We believe that a third main reason the implementation of the IMD did not take off right away was the relative unfamiliarity of ZSM with identity marketing. Notwithstanding the fact that the organization had been involved in an identity marketing process for about two years at the time, people at ZSM seemed to find it difficult to imagine how their new reality would work out, what it would actually mean to them and ask of them in their daily work. This is a common observation in identity marketing: to take on a hitherto unexplored perspective and imagine oneself acting accordingly is not easily done.

Finally, and perhaps the most mundane cause, implementation of the IMD was delayed because it was relegated to the background by every day business. With a lot of pressing issues going on within ZSM and within Dutch health care, the trade-off was easily made in favor of the well known core business, in spite of the acknowledged importance of the identity marketing route they were following.

The importance of the identity marketing process to ZSM became clear as time progressed and implementation of the IMD stood still. In spite of the aforementioned impediments, which would probably have caused many other organizations to throw in the towel, the ZSM project team grew more and more determined to overcome the impediments and to start the implementation of the IMD. They were convinced of the importance of the identity marketing approach that was spreading out through the complete organization. And they were equally convinced of the importance of having a practical and acceptable tool to manage the organizational identity and to make the results visible to all people involved. Moreover, as the various homes within ZSM continued to develop their identities within the corporate philosophy of *Share your life*, they asked for assistance in actually managing these identities accordingly. So the project team had to come up with a solution to get the IMD back on track again and they found one.

5.3 Back on track again

Two pilot projects were started at two different homes within ZSM. Both were rest- and nursing homes located in the same village, but with different identities. The identity of the first, henceforth Home A, was summarized with the sentence *Discover the power of giving*. The identity of the second, Home B, was summarized with the sentence *Experience what being welcome means*.

The same procedure was followed for both homes. The first step consisted of determining the so called 'brand pillars' for each home. Brand pillars are the three to five variables that together define the essence of an organization's identity. They are usually defined at a relatively high level of abstraction. The brand pillars for Home B, for example, were 'welcome', 'interest', and 'time'. These brand pillars were developed by a selected group of representative employees, volunteers and residents in a series of workshops as a part of the identity marketing process. The brand pillars for Home A were developed in the same way during the pilot project (unlike Home B, Home A had not yet defined its brand pillars beforehand), with the difference being that only employees were involved here. The brand pillars for Home A are 'self conscious', 'to discover' and 'to enjoy'.

The second step in the pilot project implied the operationalization of the general brand pillars into a set of specific, measureable behaviors, attitudes and processes. This took place in close cooperation with employees of both homes. In the case of Home B several residents were involved as well. The result of this stage was a comprehensive list of brand performance indicators per home. Figure 2 shows a part of the list of Home A, namely the specific part in which the brand pillar 'self conscious' is elaborated (only the first of five variables describing self conscious is depicted here).

Self conscious		
What do we mean by this?	*What does this imply?*	*What are corresponding behaviors, attitudes and processes?*
We are fully aware of our promise 'Discover the power of giving'	We know that we matter	We experience (daily) that we make a difference in the lives of others. We feel this ourselves and it is confirmed by others [attitude & behavior]
	We realize that we have much to give	We are aware of what we have to give to others [attitude] We make others aware of what they have to give [behavior]
	We realize that we are cared about	Other people show that they care about us [attitude & behavior]
	We are proud of House A and of what it stands for	We feel this inside and express it to others [attitude & behavior]

Fig. 2:Brand pillar 'self conscious'

Based on the list of brand performance indicators, the next step we anticipated was to develop, again in close cooperation with the homes, simple, relevant and easy to use brand performance measurement instruments. The idea was to introduce these instruments gradually in order to give all those involved the opportunity to: (1) get used to brand performance measurement; (2) experience that the measurement is indeed relevant, easy and quick; and, as a consequence, (3) develop a positive attitude towards brand performance measurement. We believed that this approach would simultaneously tackle the alignment issues between corporate and local identity marketing processes.

However sensible our idea might have seemed as a priori, reality made us decide to act differently. In Home A, we decided to start with one brand pillar only (i.e. 'self conscious') and to take an extra step before developing the complete set of measurement instruments as described in the previous paragraph. Instead, we formulated two relatively small-scale and short projects around two issues that are strongly related to self consciousness. Both projects run under the responsibility of a member of the project team, in this case, two different senior care employees. The reason for starting with these two projects was that we wanted to get a head start, involving many people from the house in the implementation of the IMD, reassuring them with regard to the Trojan Horse of performance measurement, letting them experience the value of the project, and raising enthusiasm for and commitment to the IMD.

In the first project, the Pride project, a brief survey was conducted under employees, volunteers and residents consisting of a set of six statements with a follow up question. An example of such a statement is: "I know what I have to give to others" (1 to 10 rating scale) in combination with an open ended question reading: "What is it? (that you know you have to give to others)".

In the second project, the Talent Project, the talents relevant to the organization's identity are mapped for employees, volunteers and residents. A so called talent card was developed on which people can assess their own talents or someone else's on a visual 5-

point rating scale. Examples of talents that are assessed are: gives responsibility to others, gets satisfaction from work and enjoys interacting with other people, is good at coming up with new things, and dares to deviate from rules when necessary. By mapping the key talents related to *Discover the power of giving* of all employees, volunteers and as many residents as possible, the home expects to be able to make more significant matches between people, creating greater value for everyone.

Although we planned a similar approach for Home B, that is introducing the IMD in a light version and in an unthreatening manner, things have not really gotten off there. There seem to be doubts about the approach chosen and self-initiative to come up with alternatives is lacking. Initial responses to the list of brand performance indicators were mixed, with a majority expressing concerns about the comprehensiveness of the list ("It's too long"), and publically questioning the connection between the listed indicators and their identity. The latter observation was somewhat surprising to us given the fact that the team members from Home B produced the indicators themselves (although not in the literal way we formulated them in the list). One of the team members, a care worker, however, was extremely happy with the list of indicators stating that "finally I know what is expected from me. Now I know how I can contribute to our brand performance".

6 Recommendations: What we have learned so far

In this paper, we have first described the development of the Identity Management Dashboard (IMD) for Zorggroep Sint Maarten (ZSM). In the second part of the paper, we have reported on the process of implementation of the IMD within ZSM. The implementation is still in its early stages and as such "the story continues" (and so does our research). Nevertheless, our experiences thus far enable us to conclude with a brief summary of a number of lessons learned.

First, this project has taught us that working in close cooperation with a partner has been and still is very beneficial. During the in-company development and implementation of the IMD we explored together, learned together, made mistakes together and celebrated successes together. The employees of ZSM with whom we worked together thus far appreciate the chosen approach. They feel as responsible for the outcomes of the cooperation as we do, and they act accordingly. Moreover, we feel that through the co-creation of the IMD and its specific measures of brand behavior, brand attitude and brand processes, employees and researchers alike have gained a deeper understanding of what their organization and their work is about. Both parties have also become more involved with one another, with the organization, and with the project at hand. Higher involvement in itself is positive, but even more so, higher involvement can lead to greater motivation of all involved parties to contribute to their mutual goal (Harrington, et al., 2006).

We know from experience that visualizing a new corporate identity ‘in action’ is far from obvious. We also know from the literature that adoption of new technologies is facilitated by helping prospective users to imagine themselves actually using the new technology. For this reason we developed the scenarios, each of which presented a specific stakeholder using the IMD. Notwithstanding our efforts, we observed that taking on a hitherto unexplored perspective and imagine oneself acting accordingly was not easily done by the people of ZSM. To be clear, these people were actively involved in the development of the new perspective. So it was not really new to them. Moreover, part of the development process consisted of visualization exercises, as in the case of Home B, where team members were asked to write a narrative about the future experiences of a prospective resident that visited Home B for the first time. Still, after having analyzed these narratives and having synthesized them into lists of performance indicators, several team members said that they failed to see the connection of the indicators with the identity they were distilled from.

At this point, we thus also learned about the key importance of presenting and communicating the performance indicators in such a way that team members can actually understand and adopt them. In hindsight, we think that our rather academic and linguistic style of presentation might have caused several of the team members to unhook, after which it is difficult to get them hooked on again.

A third lesson we learned is that building a strong brand trough identity marketing takes time and careful and systematic construction. The systematic approach of translating brand pillars into brand behaviors, brand attitudes and brand processes helps organizations to build their brand in a stepwise manner. Thus, this approach provides organizations with a solid, systematic development method that is applicable in any organization that wishes to measure its brand performance, but believes it cannot be done because “it is all too vague and abstract to measure” (We often get this response when we explain our IMD development approach).

The final lesson learned is that the importance of measuring your brand performance is not so much in the resulting ‘hard’ data, but in the process of defining what it is that you want to know and as a result making your identity real and tangible. Whereas the IMD indeed measures and monitors ZSM’s brand performance, it simultaneously supports the development and nourishment of the identity of ZSM. It helps ZSM to discover and communicate what values they find of importance and can thus co-shape the culture of the organization (Pauwels, et al., 2009).

A tangible identity shows both employees and clients what is to be expected. Clear expectations and a fair and transparent performance evaluation system (which the IMD is) positively affect employee satisfaction, even if performance is not according to expectations (Yigitbasioglu & Velcu, 2012). In addition, through the implementation of the IMD, everybody is confronted with the performance of ZSM on both a category and brand level, enabling each individual to experience how (s)he can influence both types of performance. Thus, the IMD may help professionals become increasingly meaningful workers.

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Team Academy As Learning Living Lab: European Phenomena Of Entrepreneurship Education And Development

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Abstract

Tiimiakatemia (Team Academy in Finnish), established in Jyväskylä University of Applied sciences, Central Finland in 1993 by Johannes Partanen, celebrated its 20th birthday in January 2013. Team Academy has received numerous awards for innovative learning methods and entrepreneurship development. In the year 2000, the Finnish Ministry of Education nominated Jyväskylä Team Academy as a Centre of Excellence in Education. In 2008, Finnish Minister of Trade and Industry Mauri Pekkarinen declared Team Academy a Centre of Excellence in Entrepreneurship. In 2009, 37 % of the students were self-employed as entrepreneurs within six months after graduation and 47 % of the students two years after graduation (OPALA 2013). The Team Academy learning concept is at use in several Colleges and Universities around the world including France, Germany, The Netherlands, Hungary, United Kingdom, Spain, Brasil and Argentina.

In Team Academy, students learn in teams through their legally independent co-operatives, which they establish in the beginning of their studies. "Teampreneurs" have weekly training sessions (instead of classes) with their coach, who is responsible of the team learning. The co-operative acts as a platform for authentic learning-by-doing. Co-operatives co-create services with customers and execute real projects. The annual turnover of the 11 team companies in 2012 was 2,05 million euros.

Given the track record, it is surprising that only few academic publications exist on Team Academy. The first aim of the article is to present the learning concept of Team Academy as "Learning Living Lab", based on literature review. The second aim is to describe the existing learning environment and culture based on empirical evidence captured in qualitative data. Additional aim is to define future research and development agenda for the study of the Team Academy phenomena.

Keywords

Entrepreneurship, Education, Learning by Doing, Learning Living Lab, Team Academy, Authentic Learning.

1 Introduction

"It's not a school, it is like life". I've heard this many times from Tiimiakatemia's (Team Academy in Finnish) head coach Ulla Luukas since I've started my job as a coach at Team Academy in August 2012. This was something that I thought it was, a place for authentic, experiental and experimental learning and, as we conceptualize in this article - *a Learning Living Lab*. By "Living Lab" we mean co-creation and design of innovations by users and producers in real-life experimentation environment (ENoLL 2013).

In this article, we see Team Academy as a Learning Living Lab, where t*eampreneurs* (team entrepreneurs / students) are seen both as empowered and active users of the learning environment, and also as entrepreneurs (innovators), who co-create new services with their clients. Students become team entrepreneurs in Team Academy by establishing their co-operatives with their fellow teampreneurs with no actual business plan. The plan is to engage their customers and the peer community of teampreneurs into co-creation process.

Today, Team Academy (or Tiimiakatemia) is a international brand and a learning community of over 6000 users of the learning methods, and currently there are approximately 850 teampreneurs studying in different Team Academies in Finland, Spain, Hungary, United Kingdom, Netherlands, France and Brazil (TALN 2013). Tiimiakatemia Learning Network was established in 2012 as a network for Tiimiakatemia coaches around the world. The internationalization has most cases simply started by visiting Tiimiakatemia in Jyväskylä, which was launched by Johannes Partanen in 1993 with a bulletin board message in Jyväskylä University of Applied Sciences: "*Do you want to go on a trip around the world and learn some marketing on the side? Come to class 147 at 3 p.m. to hear more!*"

That was the launch of the first team, the RTW (Round the World) -team. Since then, over 800 teampreneurs have graduated from Tiimiakatemia Jyväskylä during its 20-year history. Since then, their shared vision has been the trip around the world with the money they have earned in the co-operative.

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Given the track record, it is surprising that only few academic publications (see Pöysä-Tarhonen, Toivanen H., several authors 2010) exist on Team Academy. The first aim of the article is to present the learning concept of Team Academy as "Learning Living Lab", based on literature review. The second aim is to describe the existing learning environment and culture based on empirical evidence captured in qualitative data. Additional aim is to define future research and development agenda for the study of the Team Academy phenomena.

In the first actual chapter we describe and define the theoretical framework, central concepts, methodology and data gathered for the article. Following chapters represent Team Academy as Learning Living Lab and describe the current culture and discourses based on the gathered data and existing literature. In the last chapter we discuss of the future research and further development of the Team Academy Jyväskylä.

2 Theoretical framework, concepts, data and method

Our lenses in this paper are binary and multidisciplinary. This is partly because our role as practioners in coaching, teaching and applied research, development and innovation projects. The other lense comes from our scientific backrounds that aim to combine cultural studies and economics.

Paper has three kinds of goals, introductory, pragmatic and theoretical. Introductory goal is to act as an introductory article and to describe the learning concept as learning living lab. Pragmatic goal is to identify needs for further development of Team Academy as a learning environment. Theoretical goal is to construct a theoretical framework and define concepts for further interpretation of the cultural phenomena of the Team Academy. We also aim to identify needs for further research.

The main theoretical framework and lense is socio-constructivist and applies articulation theory developed by Laclau & Moffet (1977; 1985) and Laclau (1996), and developed also by Stuart Hall (1988;1990;1992a;1992b;1996;1997). Also selected writings related to discourse theory are relevant to our theoretical framework (Fairclough 2002, Howarth 2004).

In this article Team Academy is seen as constantly constructing community which *culture* and *discourses* are historically constructed, unstable and diverse. When we are talking about *culture*, we identify the partition to material (spaces, physical objects and artifacts) and immaterial (meanings produced in the cultural context) culture. These two are inseparable and entwined.The central concept we use to describe the production of meaning is *discourse,* which is related to the language use in the process of production of a culture. Discourse is social, shared signification of something, and it limits other ways of signification.The concept of discourse was originally introduced by Michel Foucault in the *L' archéologie du savoir* (1969).

When we discuss and interpret the Team Academy culture, we are especially referring to its micro-culture inside the community. By culture we mean shared paractises, values and discourses (discourse practises). It has not always been an institution, that it is today. By talking Team Academy as an institution we mean its current (legal) status as a Degree Programme in Entrepreneurship Development. It can be seen also as a result of constant power struggle between the existing social practise and hegemony of learning (the "traditional" school system in Finland) and the innovator, or "radicals" as was defined by one of the interviewees (Interview 5).

The primary data collected for this article is based on group interviews of Team Entrepreneurs, Coaches and personnel of Partus Ltd in Tiimiakatemia Jyväskylä, Finland. We conducted group and individual interviews for the 1st (Interview 1), 2nd (Interview 2) and 3rd (Interview 3) year teams (N=26) during spring 2013. We also conducted group and individual interviews of the coaches (N=5). We also interviewed a repreresentatives of Partus Ltd (N=2), which is a company responsible of Team Academy Adult Education, especially education of the team coaches. We also applied etnographical method. Observations have been documented in diaries during team training sessions during August 2012 – March 2013. Secondary data is a part of literary review, which includes the creation of the (theoretical) context of this introductory article.

3 Identification to the business field: the business of learning

To understand the signification process of the concept of "learning", one must understand the impact of Peter Senge's book *The Fifth Discipline* (Senge 1990) to the culture of Team Academy. Senge's backround is in organisation studies, and after Johannes Partanen applied the book's ideas in 1992, Team Academy started to construct as a *Learning Organisation* (Partanen 2012). This was not something Partanen just said, this is something that you can experience today at the Team Academy Jyväskylä. This means that the Team Academy's practises and discourses are constructed in the direction of an *learning organisation*. The five learning disciplines, 1) *Personal Mastery* (clarifying personal vision in learning, making choices), 2) *Mental Models* (testing assumptions, critical thinking), 3) *Building Shared Vision* (shared visioning process, acknowledging the current reality, allowing freedom of choice), 4) *Team Learning* (suspending assumptions, acting as colleagues, practising, surfacing own defensiveness) and 5) *Systems Thinking* (building systems archetypes) can be identified today in the everyday practises of Team Academy, especially in the appreciation of team learning, shared vision and individual learning tools.

These practises also construct Team Academy as a "flat" organisation and also turn around the social roles in the process of learning. It also directs individuals to the construction of a peer (learning) community. This all is combined in the concept of "Friend Leadership" which is in everyday use at Team Academy. Friend leadership can be described as peer leadership or equal leadership, where the vision owner is leading with own her/his volition. "A Friend Leader" is a description of a desirable social role, which is not a reality but an ideal (discourse). Friend leader concept is partially an application of Kouzers & Posners (2002) *exemplary leadership* practise, which describes the ideal practise and qualities of a (good) leader. Exemplary leader can be described as active self-manager, who leads by doing things and setting the example instead of just saying. Still, the more important thing from the viewpoint of this article is identification towards the qualities of a co-creator. "A good leader" should "inspire a shared vision", “Enable others to act” and “breathe life into the hopes and dreams of other” instead of the self. Good leadership is also about fostering collaboration, including “peers, managers, customers and clients, suppliers citizens - all those who have a stake in the vision” (Kouzes & Posner 2002, 18).

Instead of replicating here some leadership concepts, I am describing the (ideal) learners or the user identity of Team Academy. It is important to note, that while *The Fifth Discipline* was targeted to the business field and business organisations, Partanen applied the ideas into the field of education and started coaching Team Academy like it was an business organisation. He started the first “learning team” in a traditional (business) college.This was done in specific moment in Finnish educational history, as in August 1991 the experimentation of the new Polytehnics (school of higher vocational education, later Universities of Applied Sciences) started (University of Applied Sciences (Finland) 2013; Leinonen, Partanen, Palviainen 2002). This structural change created some space for innovation, as there was no practise for the new applied universities. Still, the starting point was in the conservative college practises and structures, which were based on the conventional pedagogical practise of *teaching*. When Partanen started the first team, it was challenging at times and it took time to learn a new way of learning. The students sometimes demanded traditional lecturing. The coaches role was challenging to construct as there was no existing culture or practise for it. The coach was perceived more equal to students and the students started giving straight-forward feedback also to the coach (Leinonen, Partanen, Palviainen 2002).

The “demand” for more “practical knowledge” was a driver to the birth of the new dual model of higher education in Finland. This demand was in the interests of the business, industries and the local working life. For this call Team Academy answered well, and received a Silver Cross from the Finnish Chamber of Commerce in 2000. Same year, it was nominated as the Centre of Excellence in Education by the Ministry of Education. The evaluation criteria of the latter included the assessment of the learning environment and the support for individual learning, pedagogy, employment and relations to working life (Korkeakoulujen arviointineuvosto 2013). Also the integration to universities strategies was included in the evaluation. Regardless of the evaluation, the real integration to university strategy was not there, as Team Academy was already constructed as a separate community inside the university. It had identified to the *business field* instead of the *education (let alone academic) field*, and Head Coach’s nor the Team Academy students’ attitudes toward the conservative teaching practises of the university weren’t too friendly (Interview 4,5).

4 Learning (business) practises and the otherness of school

“No Lectures. No Exams. Just put you hands in the dirt and something will come out.”, describes one of the Finnish teampreneurs on a new video of Team Academy, targeted to the British audíence before the starting of three programs of the Team Academy UK

(Team Academy Comes to The UK 2013). Team Academy is a business school, and that means also talking in business (discourse). In Team Academy this also means making business through self-aquired customer projects, not just hearing theories and models about it. The pedagogical model is represented as learning by doing, radical constructivism and exploratory learning.

The concrete platform for learning is Team Learning and the legally independent co-operatives. Independence means that the university, or the coaches who are the employees of the university don't have legal say or control over the co-operatives of the Team Academy. The university offers office (or learning) space for the co-operatives which they pay monthly rent of. Still, teampreneurs are legal students of the university, and the coaches are responsible of their learning (coaching) and in control of approving (credits) and evaluating their studies. Teampreneurs can identify as entrepreneurs or as students, legally they are both.

For the culture, the use of social power is more important than the administrative power. This means that the social setting have to support the empowerment of team entrepreneurs. Team Academy is run by the teampreneurs, and learning can be described as user or team-led (student/ community-centric). On the surface the environment seems to be self-sustainable, which could survive without the coaches. But under, coaches seem to represent many things beside the administrative power that they possess (Interview 1,2,3,4,5). Team coaches are responsible of the overall development of the Team Academy and of the team coaching process throughout the team's 3,5 -year life-span. To be responsible of the team coaching does not mean the actual results of team, but more like team learning, support and motivation.

Coaches are individuals, and so they take different social roles that affect the team performance. Business coaching and mentoring are prevailing, but models vary very much. Social models are taken from different sources, also from sports coaching. Still, there exists a desirable practise of coaching in Team Academy, partly influenced by Johannes Partanen and the coaching practise developed by his company Partus Ltd, which coaches team coaches (Partanen 2012). Partanen has created theses and seven "Johannes's laws" for team coaching, based on his 40 years coaching experience (Partanen 2012). The first law, "the law of non-intervention" (*Don't intervene when you feel like you should. Intervene when you feel like you shouldn't)* describes quite well the existing social role of the coach. The basic social model of coaching in Team Academy means that the teampreneur is active and exploratory, and coach's role is to reflect, support and encourage, motivate, challenge, ask and to offer theories and (learning) models. The coaches have at least one learning tool where they take more active role, the coaching programs. There are coaching programmes in Leadership, Marketing and Innovation.

The main method for team learning is *dialogue*, which is exercised in the weekly *training sessions*. Dialogue is understood as "thinking together" and the dialogue culture has been developing during the 20 years. This means principles of respect, listening, waiting patiently and positive straightforwardness.

Every team has two four-hour trainíng sessions every week with their coach. The teams prepare and lead the training sessions, and the coaches stay more in the backround respecting the dialogue the teampreneurs are having. Coaches more often listen, observe, ask questions than they give direct guidance and answers to questions. Lecturing is out of the question. Coaches more support self-direction and encourages exploration and experimentation of the teampreneurs. The contents of the training sessions formulate according to the current need of the team company. Usually the training session consists of 1) Check-In (unformal what's up), 2) reflection of projects (evaluation before project (pre-motorola), evaluation during and after the project (Motorola, the name adapted from American Company Motorola practises)), 3) book presentations, 4) team company development & management and 5) Check Out (reflection of the training session). For training sessions, important theory application is Nonaka & Takeuchi's tacit knowledge theory (Nonaka & Takeuchi 1995).

Training sessions have stayed as a structural learning practice since 1992, when the former head coach Johannes Partanen got the idea to get rid of the classroom desks and arrange the chairs into a circle (Leinonen, Partanen & Palviainen 2002; Partanen 2012). Nowadays the circle is called “the dialogue circle”, and it is dedicated to team learning and it is not a regular co-operative (business) meeting with an agenda. Different visualisation and presentation technology is used, but only paper notebooks and tablets are used to write notes. Laptops are often seen as distractions to the dialogue. As a method the dialogue circle is putting the participants into a more equal position. Especially if you compare it to traditional classroom setting where the teacher is more or less “invited” in the front to talk to the students, whose role is to listen.

Typically the process of learning starts with a customer visit, doing projects with real clients and simultaneously applying theories to practise. This is one of the most central processes or practises (passed on by coaches and peers) that is in use at Team Academy, and it is called the ATP (Applying Theory to Practise) model (Lehtonen 2012; Partanen 2012). The applying of the ATP model is visible in different practises: in pre- motorolas (evaluation before projects) and motorolas (evaluation of the projects), book presentations and essays.

“The Team Academy Books of Books” (later BoB, also called as entrepreneur's best books) -guide (Partanen 2010) is a central and interesting artifact, which has a structural impact on the culture and constantly constructs the learning field and the models and theories circulated inside the community. BoB is important element of existing structure in the studies. Teampreneur's simplified “theory-driven” learning process starts from 1) opening BoB, 2) choosing a book, 3) reading the book and 4) applying the "theories" into practise. Every teampreneur collects 120 “book points” (60-70 books) in 3,5 years by reading books and writing essays about the books. Nowadays the essays are restored in public essay bank on the internet (http://esseepankki.tiimiakatemia.fi/).

In "practise-driven" learning process, teampreneur 1) starts a customer project 2) applies "theory" in each phase (planning, execution and evalution) of the project 3) Ends the project and continues co-creation with the customer.

Practise-driven ja Theory-driven processes presented here are example processes, the practise and reality itself is more heterogenous. The question how well theories are applied into practise and what is the quality of learning is another research question and needs further investigation.

The author of the BoB Johannes Partanen is a very active reader. BoB is now at its 23rd edition (Finnish edition) and every edition includes several new titles. All together the guide (Finnish edition 2011) includes 1019 books. For the identity and skill construction point of view it is interesting to list the domains of the evaluated and listed books: 1 Learning 2. Community 3. Entrepreneurship 4.Leadership 5.Coaching 6. Marketing 7.Innovation and 8.Spiritual Growth. By genre, books are mostly popular business books, but the guide also includes fiction (You get to read Paul Coelho, Dalai Lama and Pierre Bourdieu if you wish). Stories are appreciated as is the *Experience Economy* phenomena (see Pine & Gilmore 1998). This implies that learning should be fun, and one should offer experiences not services. This is seen in the most community events as in the, "Rocket Days", "Houston Call", "Happy (torment) Days" (In the end of semesters), and "24h Birthgivings" where presentations aim to fullfill the 5E's of the experience (Applied from Experience Economy by Pine & Gilmore 1999; Entertainment, Escapism, Education, Esthetics, Espirit of Team Academy).

BoB can be seen also as a power structure, and it is written by a single person. Of course any given study plan represents always a (closed) power structure. Still, the variety of the BoB is broad, even multidisciplinary, still representing the field of business.In addition optional books can be proposed by the teampreneurs.

"Birthgivings" are also an important learning practise in the Team Academy. Every team company has annually four birthgivings concerning their own team company development or executed for a customer. Birthgiving is a form of problem-based learning, and usually the briefing presents a challenge or a problem, which is solved during the birthgiving. In the end of the studies, team company delivers a "24-hour birthgiving" for a customer. This birthgiving is a skills test, where the team company show their skills. In addition to 24-hour birthgivings, the teampreneurs write their thesis which often are business plans, customer research or service development for a customer.

Almost every learning and discourse practise is about identifying in "authentic" business practise and so they are differentiations of school practises. The word "school" and the practise of "going to school" is causing immediate reaction as the teampreneurs identify not as students but as entrepreneurs: "we are not in school, we're coming to work in our own business office every morning". This is a element of of culture that is passed to the first year team entrepreneurs, also by the coaches, and so affecting the identifying prosess as entrepreneurs, not as students. Still at least part of the teampreneurs identify also as students. Some might even talk about going to "school" on purpose as they resist too strong attitudes towards "studying" (Interview 1). They are also legally students as they are a part of the co-operative.

5 Team Academy as a learning living lab

In Team Academy the expression "a learning project" represents projects where there is no monetary income. This is a basic frontier between business and learning (or education). The most desirable project is one with both: money and learning challenges. The community lives and learns through projects, only through projects teampreneurs get the valuable experiences what to reflect on and to build up ones personal skills and vision. Coaches and the community also encourage to "fast (and bold) real-life experiments". The purpose is to learn and to explore new things and then evaluate the project value a) for the learner (user) or b) for the customer. In this sense projects can be a) student (user)-led or b) customer-led. In this case we define the "user" as the user of the learning environment (teampreneur) or the learning living lab.

Every team company has a dedicated office space in Team Academy which they pay rent of. It is a open-space office where the information flow between the team companies is easy. peer-to-peer learning seems to be effective, and the first year teams learn "house (existing) practises" from older teams. In 2012 all the 11 teams were divided into three "Colour Academies", where each Colour Academy (green, yellow, and blue) included 3-4 (1.2.3.4.year) teams.

The Team Academy space has been mainly designed by the teampreneurs. Self-direction and peer-to-peer learning can be also a challenge for the community, because the culture is not always passing on the best practises that exists. This usually happens if the community is not critical or open to new ideas outside the community. That is partly why development ideas in the interviews (1,2,4,5) included increasement of openness - (open innovation). Openness was meant to reach out to the world, but also tolerance for diversity and openness for new ideas inside the community. More freedom and tolerance for diversity was also wanted inside teams (interview 1,3).

The team company dynamics builds on trust and shared goals. The typical measures of the team companies are turnover, book points, project quantity and customer visits. These act also as individual measures. That is why mere "learning projects" are not enough for team companies/ individuals. Real company has expenses, and it needs its services and products, customers and sales. This can be a challenge for learning, as skills and the development of new services need time and exploration before exploitation. But how to manage this process with 20 fresh teampreneurs who just ended high-school ? Most of them don't have any experience nor have no special skills.

After orientation with their peers (teams have a rented team leader from 3rd year team for the first fall to help to get their business up and running) and establishing their new co-operative, team companies start their learning journey in the first fall wíth *customer weeks*, where all team companies rival who does the most customer visits, offers and deals.

This is the start of the customer process, which is modeled in the *rocket model*. Rocket model is a tool for “creation of teampreneurs” and for evaluation of team companies. It contains 14 processes of the team company (including individual learning process, team-company learning, coaching process, leadership, financial, brand management, innovation..) which here we are especially interested of the three customer processes (The Process of Potential Customers, The Process of Marketing / Customer Service, The Process of Customer Relationships). The ultimate goal of The Customer Processes is producing shared value for your customers.

In the Living Lab model the idea is actually to co-create value with the whole ecosystem: with the customers and by the end-users of the service. This means the construction of user-led open innovation ecosystem and especially seeing end-users as an integral part of the innovation process. This can be related to think Living Lab as a community, where end-users/ consumers identify themselves with a brand or as an active citizens (in public sector).

Team Academy as a Living Lab is different from a pure industry-driven (or Utilizer-driven) living lab which engages their end users to the innovation process of their service/ product. It is more like a combination of user-driven and industry-driven living lab (See charasteristics of Living Labs in Leminen, Westerlund & Nyström 2012). Although the co-operatives can be seen as industry-driven, their main goal is learning and skill development.

Team Academy has situated in Lutakko area in the City of Jyväskylä since 2000 (although Team Academy is based temporarily in Savela district 2012 because of building renovation). In Lutakko area, Lutakko Living Lab has been one of the most advanced Living Labs in Finland executing experimentations, projects (withs hundreds of students) and engagaging citizens (Krawczyk & Ruuska 2010, Krawczyk & several authors 2011a; 2011b; 2011c; 2011d;). Teampreneurs have also been a part of the particular living lab –projects (especially ilutakko citizen platform & timebank, see http://www.ilutakko.fi). Lutakko Living Lab can be described more an provider-driven living lab (it provides research information, concepts and opportunities for business).

6 The construction of Team Entrepreneur’s identity

”Screw it, let’s do it”, would Richard Branson say. Celebrated serial-entrepreneur Branson visited in Jyväskylä in Nordic Business Forum -seminar in September 2012 and represented a figure for identification also for a crowd of (team) entrepreneurs, who went to see his speech. This describes one of the desirable characteristic of an “free” teampreneur who is ready to take challenges, risks and to throw him/herself into the personal “discomfort-zone” and do fast and bold experimentations. It is also desirable to be able to accept and to be proud of failures. This all should be “fun”, “creative”, playful and a bit crazy sometimes. Uptightness, and formality is not desirable, straightforwardness, authentic, open, social and laid-back attitude is preferred (Interview 1,2,3,4,5.).

Still, there are different voices (identities) inside the community. Most of the teampreneurs are practioners, who see the world especially as a *doable* space. Maybe that is why the mental model of experimenting and exploration by doing/action is desired. But still many of the teampreneurs must learn new way of thinking and learning in the beginning of studies.

In the group interview, the first year teampreneurs described the first months as “chaotic” or a “roller coaster”, as “no one said what to do” (Interview 1). After the first months some said that their thinking about things has developed rapidly comparing their friends outside the Academy. “It has been educative and developing experience”, to think things yourself, and taking responsibility of yourself and the team.

The responsibility to the team was experienced also as distressing and painful, as the “team rules” (have to be just in time, have to show up in the office / meetings as everyone else, have to achieve shared goals) were experienced like “you were in the army”. On the other hand there is freedom of choice in learning, and on the other there is making money for the co-operative and team rules. In the coach interviews (interview 5) team learning was seen as the elemental learning platform and as support for learning and risk taking, but also a possible threat for innovation – teams can unify individuals and strong community culture affect innovations. The community culture was seen very strong, sometimes even too strong. Some also identified “a house discourse” (“Team Academy’s own language and jokes”).

The first year teampreneurs reported that they have adapted a new way of thinking, which is more entrepreneurial and “more aware of what’s happening in the world”. The teampreneurs also experienced, that learning in authentic projects was resulted as better learning and understanding of their own development and what they have learned (customer behaviour, financial issues, sales, marketing and generally business practises and opportunities) (interview 1).

The first year teampreneurs were struck the reality of “not being a student but an entrepreneur. The frontier between “entrepreneur” and “student” was raised in discussion concerning vacation (whether entrepreneur should have school vacations) (interview 1).

The teampreneurs also experienced improvement in presentation skills and communication skills. (increase of courage). They also experienced that they have developed “the intrinsic need for learning (skills), and when you do (things), you’ll learn.” Some experience after eight months that their self-confidence has boomed: they experience “that they can do anything.” Still many of them don’t yet know what skills they want to develop and how to apply theories properly. This still seems quite empowering starting point to learning.

When interpreting also the older teampreneurs’ statements, the one of the most important skill that they report are the “skills for learning”, that they describe to have obtained through self-direction and increase of self-knowledge (Interview 1,2,3).The increase of self-knowledge is most commonly reported and important development of the teampreneurs.

Team Academy offers individuals a lot of feedback of their own actions from their peers (dialogue sessions, working together in projects). Also different feedback sessions and open reflection practises are common. As a part of individual learning process support, the individuals are having also development discussions with team coach and team leader. Everyone has their own personal “learning contracts” (applied from Cunningham 1994) and goals which are often reviewed. On top of this, there is a tool for individual learning. The “Skill Profile” is used to (self-) develop 21 teampreneur skills (Lehtonen 2012).

The ultimate goal for many in the Team Academy is to find their vision or “their own thing”. This is usually an idea or opportunity to start their own business. There is also a small group of teampreneurs who have developed ideas already at early stage of their studies. When the start-up is being set up, that seems to be a challenge from the team company perspective. Many start-ups can then move into “courageous path” where they are free of the obligations of the team and they can concentrate to develop their own business.

7 Discussion: Future research and development

The first aim of this article was to act as an introductory article, as there were not an academic publication existing about Team Academy. On top of this we have constructed and conceptualized Team Academy as a “Learning Living Lab” which is a novel formulation of the Team Academy, and also a new kind of conceptualization of Living Lab concept, where entrepreneurship, learning and community (or culture) is put together. New conceptualization does not bring significant added value to the original learning model and environment created by Johannes Partanen and the users (teampreneurs) of the environment, but it brings the co-creation of innovations at the fore, which is not yet structured in the rocket model or is not evident yet in teampreneurs’ actions at Team Academy today. This is a potential that can be highlighted when developing the Team Academy concept further.

In addition to the description of the current learning practices, we have started the work to describe the existing culture in Team Academy Jyväskylä. This article has limitations, as the qualitative data is limited to few interviews. Ethnographical observations during the last months increase the reliability of the data on a social practice level, but the deeper and more detailed analysis of the practices, especially discourse practices is missing from this article. We suggest that data collection should be continued to verify the interpretations presented here and to find new data and formulate new research concepts and questions. In addition, Living Lab and Service Design –approaches and action research could be used as a development framework/methodology.

Our third aim of the article was to define future research and development agenda for the study of the Team Academy phenomena. Due to the data limitations, a more data gathering should be done on the issue, which helps more systematically identify community needs for development. Still we can present some findings based on the ideas of the interviewees and of our own reflection.

In the future Team Academy would need to start to collect and analyze long-term quantitative and qualitative evaluation data from the team entrepreneurs and alumni's. Some basic quantitative feedback has been gathered and research is done by the university (quality system, ministry of education), but additional research would help to better understand the processes of entrepreneurship education and development. Team Academy doesn't have its own RDI department or resources, which is a weakness of the organization. On the other hand the teampreneurs represent the house RDI, and the results in entrepreneurship education, development and innovation are very good. Still, with current institution and track record the research and development resources should be strengthened.

Better support for start-ups was one topic on development agenda that teampreneurs and coaches raised up in the interviews (Interview 2, 5). Team company is the platform for learning and personal development, but it seems that the team community doesn't support enough the development of the individual start-ups. On the other hand start-up coaching inside the community would need additional resources.

Multidisciplinary teams were suggested by the coaches as an idea for future development. It has been in the planning process for a long time, but so far experimentations haven't been executed. Two new teams have been started in the hospitality services unit, and the experiences are promising. Still there are also challenges in changing the learning methodology from the traditional model to coaching teams. In the fall 2013 new teams start in the wellbeing unit. So far Team Academy has produced start-ups especially in the field of services, especially in the form of marketing agencies, business consulting, coaching, event management, retail and ICT (See 17 entrepreneur's stories in Leppä 2013).

Increasing *openness* was brought up both by the teampreneurs and coaches. This means openness inside and outside the community. The openness inside a community means tolerance for diversity, openness outside the community means open innovation and getting ideas outside the community. Team Academy has a new 5-year vision "*Glocally Blasting 4.0. Transteampreneurs*". The vision is still an abstraction and needs engagement of the teampreneurs. Still, the vision seems to carry the values that the community still increasingly needs and values, openness.

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Technology Transfer And Entrepreneurship Support At The Algarve: The Case Of Cria

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Abstract

Theoretical approaches in the context of innovation, like "Triple Helix", place the density of relationships between university, industry and government in the center of the innovative process. The model stresses the importance of Universities in innovation, since a crucial part of R&D is carried out by these institutions. Portuguese Universities have formalized in the last years an active strategy towards the implementation of an effective linkage between University and Enterprises. Sustained and encouraged by national public initiatives, and constituted by qualified human resources, universities have consolidated technology transfer units directed to the education, promotion, and support of entrepreneurship as well as to the transfer and commercial approach to knowledge and technology through the spin-offs created in the academy. Additionally, from specific regional gaps, some universities have also developed programs aiming to increase tech-based start-ups and spin-offs. At a regional level, the University of Algarve (UALG) has anticipated national policies to support knowledge based entrepreneurship (NEOTEC) and technology transfer (OTIC), by developing in 2003 an internal structure focused on these topics. Created from a partnership between the University of Algarve (Research), CCDR Algarve (Government - Regional Authority for Planning and Coordination) and ANJE Algarve and NERA (Industry) as an answer to identified problems in the region (gap between research and enterprises and adverse environment to innovation), the Algarve Regional Centre for Innovation has developed a crucial role in promoting innovation and entrepreneurship. Now, as a formal unit of UALG, the Division of Entrepreneurship and Technology Transfer (CRIA) is a key player in the development and implementation of a regional innovation policy. The planning and implementation of sustainable initiatives, built on triple helix model cooperation's and materialized on specific programs directed to the promotion of Intellectual Property Rights mechanisms, Entrepreneurship Support, and Technology Transfer and Commercialization, have resulted in an increase of patents with potential commercial value registered in the University, in new and innovative start-ups and spin-offs competing in international markets and employing qualified human resources, and to new R&D partnerships with exiting companies. As showed by this study, the outcome of the actions developed by this agent is a more innovative, competitive and entrepreneurial economy, where the policies and goals of the different economic agents (University/Industry/Government) are aligned, reducing the gap between research and market.

Keywords

Innovation, Entrepreneurship, Technology transfer, Regional Development, Triple Helix.

1 Introduction

Technology Transfer and University based Entrepreneurship areas have gained increasing relevance as a way to value knowledge and promote innovation in the regions, transforming know-how and scientific knowledge into valuable economic activity and qualified employment.

Science and technology have become important to regional developments (Braczyk, 1998). In this sense, Universities have a significant role to play in the local economy (Love, 1988; Bleaney, 1992), whether direct or indirect, not only in creating and disseminating knowledge and training human resources, but facilitating the interaction between knowledge and industry (Bozeman, 2004).

Knowledge transfer, whether direct or indirect, include tacit and codified knowledge (Polanyi, 1967), posing a challenge and an opportunity to Universities. In this sense, codified knowledge is easy to reply and disseminate. However, tacit knowledge is sometimes impossible to codify, making it very difficult to formalize and communicate (Nonaka, 1991), requiring the reinforcement of social interaction between the several agents, making it more difficult to manage. The concept of tacit knowledge in this case aims to reinforce the relevance of Universities, since most times, despite the created and codified knowledge that these agents are responsible for, when aiming to promote and strengthen the cooperation with Industry, it is often the unexpressed knowledge and experiences of organizations and their human resources that provide the unique competences that cannot easily be replicated by competitors, and that assures competitiveness (Barney, 1991).

Universities have been increasingly involved in commercializing research results, aiming to generate income and promote the relations with industry, including educational initiatives, protection of Intellectual Property (IP), market search of commercial opportunities for the IP portfolio, coaching and establishment of commercialization plans for specific technologies and IP, promotion of entrepreneurship, or coaching and support of new business ventures and entrepreneurs.

In this sense, having in mind the continuing changes on the world economy and in the challenges faced by all the economic agents, the existing linear model expressed in terms of ‘‘market pull’’ or ‘‘technology push’’ has become insufficient to induce transfer of knowledge and technology.

The Triple Helix series of conferences (Amsterdam, 1996; Purchase, New York, 1998; and Rio de Janeiro, 2000), served as a venue for the discussion of theoretical and empirical issues by academics and policy analysts (Leydesdorff, 1996).

Different possible resolutions of the relations among the institutional spheres of university, industry, and government can help to generate alternative strategies for economic growth and social transformation.

The Triple Helix states that Universities can play an enhanced role in innovation in increasingly knowledge-based societies. The underlying model is analytically different from the national systems of innovation (NSI) approach (Lundvall, B., 1988; 1992), which considers the firm as having the leading role in innovation, and from the ‘‘Triangle’’ model of (Sábato J. , 1975), in which the state is privileged (Sábato J. M., 1982).

Not surprisingly, the effects of these transformations are the subject of an international debate over the appropriate role of the university in technology and knowledge transfer.

Regarding the existing configurations of the Triple Helix model, three (3) different analyses can be found, according to (Etzkowitz, 2000). In the configuration presented as Triple Helix I the state incorporate academia and industry as separate agents, and coordinate the direct relations between them. This is a static model of the University – Industry –Government relation, found especially in the former Soviet Union, and characterized by a weak capacity for bottom ups initiatives, where innovation is not encouraged.

The evolution of this model is expressed in the second policy model – Triple Helix II, separating institutional spheres with strong dividing borders and with rigid relations among the spheres, defining a “lasses-Faire” model of University – Industry – Government relation, intending to act on the limitation of the first model.

Finally, Triple Helix III model conceives a knowledge infrastructure that overlaps the different institutional spheres, namely University, Industry and Government, where each entity takes upon itself the role of the other, generating from these intersections hybrid organizations. This model has become a goal for most countries/regions aiming to consolidate an innovative environment of knowledge based entrepreneurship (consolidating on the promotion of high value spin-off and start-up firms), joint initiatives among Universities, Industry and Government towards knowledge based development, and strategic alliances among this three entities.

2 Development

2.1 Institutional framework of CRIA

The Algarve is a Portuguese region highly specialized in Tourism, characterized as the main vacation destination for the Portuguese and an important destination for the English, Irish, German and Dutch. From 1991 to 2001, the region showed the highest population growth among other NUTS II level Portuguese regions. The economic sector with more expression in the Algarve is therefore the tertiary sector (trade and services), resulting from the region's main economic activity - tourism. This activity sub-sector assumes such importance in the Algarve which is directly and indirectly responsible for approximately 60% of total employment and 66% of regional GDP.

In the present EU Financial Framework, from 2007 to 2013, the Algarve has abandoned the classification of Convergence Objective (group of EU NUT's II poorest regions), assuming a "phasing-out" period, that resulted in a significant decrease of European Structural Funds available in the regions directed to support companies through the promotion of innovation and R&D.

As for the Algarve Regional Center for Innovation (CRIA), was an initiative launched within the Regional Program of Innovative Actions (InovAlgarve project, 2002-2004). With a total budget of about €0.5 million (80% funded by ERDF), the establishment phase of CRIA involved four main regional stakeholders: the Regional Coordination and Development Commission (Algarve CCDR), the University of Algarve, the National Association of Young Entrepreneurs (ANJE), and the Algarve Business Association (NERA).

Located at the only public university in the region – the University of Algarve – the Centre was created to be a key element of the regional innovation system aiming at connecting the other stakeholders and contributing to more coordinated actions. In particular, the insufficient cooperation between the science and business communities, the limited technology transfer activities between the University of Algarve and the regional economic sectors, the lack of actions to protect intellectual property rights, and the need to promote innovative, technology-based entrepreneurship were among the regional weaknesses that CRIA was supposed to address (Pinto, H, Guerreiro, J., 2008).

Consolidated in the structure of the universities in 2009, from the definition of the new Legal Regime for Higher Education Institutions (RJIES) proposed by the Ministry of Science, Technology and Higher Education (MCTES), and following the approval by the General Counsel of the University of Algarve on December 16th of 2009, CRIA has become a formal division of the University, under UAIC (Unit to support scientific research and post-graduate training), formally known as Division of Entrepreneurship and Technology Transfer.

This regional analysis is extremely relevant, since while extensive research have been developed in examining the University-Industry linkages in the scope of strong research Universities situated in developed high tech entrepreneurial environments (Zucker, 1998) (Van Looy, 2003) (Colyvas, 2002), mid-level regions like the Algarve, have been largely overlooked.

Knowledge transfer from Universities in the so called mid-level regions have some particular constraints that need to be taken into consideration, since most of this regions are facing economic stagnation in traditional industries due to global competition. In this sense, (Clarysse et al., 2005) show how differences in the local environment around Europe influence the nature of the incubation process for spin-offs and the type of spin-offs created, enhancing the fact that Universities may also generate other types of knowledge and technology transfer.

The interaction process among Universities and Industry is usually constituted by a diversity of actions, leading to spinning off of new and innovative ventures (whether spin-offs or start-ups), licensing, research contracts, consulting activities, and graduate and students mobility, among others. Universities can, therefore, promote and support the creation of mechanisms, capacities and infrastructures to attract and capture new and existing companies willing to develop their R&D capabilities locally, acting as a source of credibility and knowledge to spin-offs and start-ups.

In order to facilitate and promote the relation and the matching of needs and resources between science and industry agents, it is important to promote the role of intermediaries able to speak both languages, such as technology transfer offices (Wright, 2008).

This intermediary agents aim to improve communication of knowledge between academia and industry, promoting the development of R&D for the benefit of companies, from university to industry and from industry to industry, through mutual collaboration, acting as a central agent of intermediation and encouraging the University as a central player in the innovation and entrepreneurial process.

Entrepreneurs are often agents of both tacit and codified knowledge in a specific sector, potentially providing skills enabling spin-offs or start-ups to access customers and suppliers (Franklin et al., 2001). Also, Venture Capitalists (VC's) and Business Angels (BA's) often assume technological skills to support entrepreneurs and companies access additional assets, as well as to facilitate links with external corporations towards acquisition or collaboration, developing their markets and becoming more competitive.

While it is easy to understand that regarding tacit knowledge the existence of close relations between academia and industry is able to promote the exchange of practices and experiences towards innovation and more competitiveness, regarding codified knowledge, a small research base is enough to build a patent portfolio, leveraging the University resources, at a more cost efficient way.

This is the gap that originated the creation and that guides the work of CRIA, acting an interface agent among the multiple agents, in the different sectors of the economic sector.

2.2 Activity profile of CRIA – Promoting entrepreneurship

As mentioned before, Universities play an important role on the promotion and creation of innovative spin-off and start-ups, valuing codified scientific and technological knowledge or tacit knowledge and experience from researchers, students or professionals from external companies. In the case of codified knowledge (for example a patent), whenever there is a potential benefit for the end user or an increase of competitiveness for a specific industry sector, it can be formally transferred and licensed to an established company. Alternatively, in some cases, the transfer itself may prove to be insufficient given the relevance of tacit knowledge associated, requiring for the creators of that knowledge to be part of the process, and sometimes, part of the entrepreneurial team responsible for exploring the commercial value of a given technology.

University spin-offs are defined as new ventures originating in the academic environment, and usually based upon codified knowledge, resulting in businesses developed under licensing agreements from the Intellectual Property (IP) owned by the university. In contrast, start-ups are companies where the role of the university has been relevant, but where it does not have any formal ownership over the IP, representing an innovative new venture where knowledge is essentially tacit.

From this intermediation, most of the spin-offs and start-ups implemented in the region benefit from the critical mass in research equipment and knowledge diversity that the University as to offer, whether before or after the spinning off or starting up process.

As a policy for regional development, an important factor to consider, in particular in periphery regions, is that spin-off companies overlap the regional dimension, commonly acting on a national and international level. According to Clarysse and Bruneel (2005), around 80% of the spin-offs realize more than 50% of their sales outside the country/regional state in which they are created. Start-ups on the other hand, although not necessarily implying a formal transfer of technology, may have a more regional dimension, play an important role in knowledge transfer from the Universities, promoting employment trough the creation of highly qualified jobs in the region and the approximation of this companies towards the research centers of the University. On average, less than 5% of the start-ups have more than 50% of their sales outside the country. Also, acting more locally then spin-offs, start-ups can prove to be a very positive way of stimulating regional development.

Start-up companies have a more regional dimension and may have an important role to play in terms of creating employment in the local region. In contrast to the spin-offs, less than 5% of the start-ups have more than 50% of their sales outside the country.

As an approximation to the region of Algarve, and to the case of CRIA, Polt et al. (2001) argue that spin-offs and academic start-ups are particularly relevant in regions where the industrial sector is weaker. Also, Universities are more likely to spinoff companies where they are not able to capture the full value of their technology through a licensing arrangement (Franklin et al., 2001).

At a regional level, the University of Algarve (UALG) has anticipated national policies and specific programs created to support knowledge based entrepreneurship and technology transfer, by developing in 2003 an internal structure focused on these topics.

On May 15th 2005, CRIA applied to the NEOTEC initiative, managed by the Portuguese Innovation Agency (Adi), through a partnership composed by regional key stakeholders in the areas of entrepreneurship and business development, namely UALG (University of Algarve), ANJE (National Youth Association of Entrepreneurs) and NERA (Business Association of the Algarve). The project was named Algarve CriaTECH, and aimed to support the creation of technology based companies in the Algarve region, presenting 3 (Three) main axis, namely the promotion of new technology based business ideas and opportunities under the scope of the University of Algarve (1), coaching to the entrepreneurs of the new business ideas contest developed by the University in 2004 (2), and the creation of national and international cooperation networks towards cooperation and technology transfer.

Also in 2005, under the opportunity created by the OTIC initiative (also managed by Adi) to create an infrastructure in the University of Algarve directed to manage the University-Industry relations, CRIA implements the Algarve TransferTECH project, aiming to formalize and consolidate its work in the areas of knowledge and technology transfer in the Algarve. Under the guiding principles of innovation, networking and economic sustainability, the technology transfer office is implemented, working on 4 axis, namely university-industry cooperation (1), cooperation networks (2), knowledge scouting and competences (3), and coordination and evaluation (4).

Both this projects played a vital role in the implementation of a true technology transfer and entrepreneurship support strategy in the University of Algarve, allowing the mechanisms to gather human resources, partners and good practices for a successful activity.

Nine years after its foundation, CRIA has currently a dedicated team of 15 staff members working in the areas of IP, Licensing and Commercialization of IP, and Entrepreneurship and Business Support, supporting researchers, students, entrepreneurs and established companies.

The office is arranged in 3 main areas, namely Intellectual Property Rights (IPR), Management and Commercialization of the Intellectual Property Portfolio of the University, and Promotion and Support to Entrepreneurship and Innovation.

In the first area (IPR), through its Industrial Property Office (GAPI), the Centre is helping about 50 users (researchers, entrepreneurs, and implemented companies) every year in protecting technologies and inventions through patents, trademarks and registered designs. In the last years, it has supported the registration process of 43 (number) patents from the University of Algarve. In all these knowledge and technology transfer activities, the CRIA has in total involved about 40 (Forty) researchers and 60 (Sixty) companies.

As regards to the management and commercialization of the IPR portfolio of the University, CRIA has so far participated in 19 (Nineteen) RTD projects with the industry, scouted and promoted around 10 (Ten) technologies with market potential, licensed 3 (Three) technologies and contributed to the development of 31 (Thirty One) technologies towards the market.

Moreover, as a support to this area, it has often organized (and continues to do so) innovation fairs and brokerage events, bringing researchers and entrepreneurs closer together.

As regards to entrepreneurship and innovation (third main area of expertise), CRIA has regularly organized business ideas competitions to identify entrepreneurs and innovative/knowledge based ideas, offering support for business planning and company creation, as well as awareness raising events on entrepreneurship that are frequently organised at the University of Algarve for students and researchers. The Centre has also launched promotional activities on entrepreneurship in the regional media, including a programme at a regional radio station.

Since the beginning of its activity, CRIA is contacted by an average of around 10 potential entrepreneurs with business ideas each month. Following the first contact, and the analysis of specific factors (experience and knowledge of the entrepreneur, technical validation, market look, IP scope, among others), after a positive decision, the entrepreneurs is supported in all the development phases, namely proof of concept, business plan, location and licensing, investment and financing, networking and internationalization.

Since CRIA begun actively working in the area of entrepreneurship support, with the consolidation of a professional team of 3 people in 2005, the Division has supported the creation of 12 spin-offs and 34 start-ups, assuming a survival rate of around 65,22%, and a business volume of around 2,53 Million Euros (Own Source: 2010).

Moreover, CRIA continues to play an active role in the regional innovation system, promoting entrepreneurship and innovation in the region in cooperation with the public and private agents, and acting as an interface between the knowledge created in University, the needs of Industry and the definition and development of regional policies by the regional government entities and municipalities.

The division has also been active in the provision of information to the regional players on regional, national and trans-national funding programs on R&D, innovation and entrepreneurship and has itself been strongly involved in trans-national projects in those areas.

2.3 Parnerships and networking at a European Level

In order to leverage the development of this interaction among university and industry, and capitalizing from international best practices and networks, CRIA has supported its entrepreneurship and technology transfer activities under the scope of European Union (EU) cooperation programmes, namely trough Transnational, Trans border and Atlantic funded partnerships. This situation allows for the incorporation in European networks of innovation, directed to the interaction among universities/research centres, enterprises/business associations, and local/regional government.

At a regional level, the University of Algarve, has used this networks to develop a global presence in areas such as Marine Economy, Tourism, Arts and Heritage, and Wealth, food and well-being, characterized as the main areas of knowledge and R&D.

At a more specific level, the division of entrepreneurship and technology transfer of the University of Algarve, has supported a great number of core activities in these areas supported by a med programme supported project named MED Technopolis, directed to the implementation of a Mediterranean network of Technology Interface Structures of the “Tecnopolis” generation for the renewal of the existing Technology Interface Structures and extension to new areas and a large number of medium and small cities in the Mediterranean, the dynamics of innovation, of the knowledge economy and of the information society in general. According with the goals pursued by the partners, the project aims to “promote innovation and the knowledge economy in the MED regionsbased on economic and social development of the Technology Interface Structures and medium and small cities to open the way towards sustainable development of these regions”. Under the scope of the project, and supported by a network of 13 partners from countries such as Portugal, Spain, France, Italy and Greece, matching needs and sharing knowledge, the University of Algarve as been able to implement a technology interface structure capable of receiving and supporting entrepreneurs, companies, investors and researchers, towards the development on new, innovative and knowledge based business ideas, resulting in 10 new high value companies, directed to international markets, therefore promoting innovation, employment and regional competitiveness.

3 Conclusions and recommendations

This paper has analyzed the framework on which Universities can promote an active role in the valorization and commercialization of knowledge, whether tacit or codified, not only for financial income, but also as a strategy to promote regional development and employment.

By working actively on technology transfer and entrepreneurship, and assuming a central role in the University – Industry- Government relations, Universities are contributing for the reduction of the knowledge gap, intermediating the needs and resources of the economic agents, and promoting the development and competitiveness of both the region and its economic agents.

Spin-off companies are born with a larger potential scope, assuming national or international markets. Also, these entities can act as an entrepreneurial boost on academia, representing good practices and potentially creating high value for the regional economy, generating local employment, and in particular high skilled employment. As for start-up companies, represent a good alternative for active Universities willing to play an important role in the regional economy and promoting its relations with industry, but who fail to have a large IP portfolio (codified knowledge) for commercialization. As showed, start-ups are usually characterized as smaller companies with a more direct business model. Also, the employment creation tends to be essentially local, valuing tacit knowledge, and acting more efficiently on regional development and employment.

By stimulating academic entrepreneurship based on both tacit and codified knowledge, a potentially growing number of spin-offs and start-ups may be created, acting as a positive impact on the creation of skilled jobs in the local economy and promoting the international recognition of the research base of the university.

The University of Algarve has been an active player in the areas of entrepreneurship and technology transfer, anticipating trends and adapting to the national and European policies on innovation and regional development, exceeding its role as academia and fully adopting the third mission as a way to act on the region, assuming a leading part in the triple helix model, and serving as an intermediary between knowledge, industry and government.

The University has fully supported in the last years an active policy towards entrepreneurship and innovation, developing the creation of knowledge based spin-offs and start-ups, and bridging the gap between university, industry and government. Also, the networks developed, and the outputs obtained since 2003 have gained the recognition of the entrepreneurs at a regional level and attracted partners in both public and private sector, namely Venture Capitalists, Business Angels, Business Associations, Science Parks, Public Agencies or Municipalities, aiming to enhance the creation of these companies, and supporting companies and entrepreneurs in areas such as financing, location an incubation, licensing, coaching, networking and so on.

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Start-Up Company And Spin-Off Advanced Partnership Via Web-Based Networking

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Abstract

University and industry cooperation (UIC) is an acknowledged catalyst for innovations and progress in computer science and information technologies. At the same time, a science to business–business to science (S2B–B2S) model of interaction depends on location. In some countries, this model works naturally with a high level of effectiveness, while others experience a high level of discrepancy between academic and industry work. The present study is dedicated to the problem of S2B and B2S cooperation in the Ukraine as an example of a country with a history of IT outsourcing companies, while lacking its own Silicon Valley and internal software products. The Ukraine is famous for its highly qualified programmers and scientists, yet it still faces a set of challenges to implementing the planned incubators or innovation centres as demanded by the government, investors, and large corporations. Effective UIC is therefore needed to cope with this situation. This paper addresses the mutually beneficial scenarios of cooperation between companies and universities worldwide. This issue is applicable and interesting for a wide audience. All information was gathered based on the authors' experiences and considerable networking with representatives from universities, small and large IT companies, and R&D companies. A partnership between start-ups and university spin-offs, named as an "advanced spin-off," is proposed as the most promising UIC model.

Cooperation with start-up companies has many mutual advantages that are described and analyzed in the present paper. A case study is described using the real-life example of advanced spin-off between Sealpoint Company and the National Aerospace University (KhAI). The challenges that were encountered included the absence of efficient networking and the differences in the team cultures of the industrial developers and university researchers. As a result, a common solution is proposed as a special web portal for general UIC networking and specifically for S2B marketing. Conducting advanced spin-off projects via such web-based networking is explained and the requirements for the portal are described. A first prototype is presented.

Keywords

Start-up company, university spin-offs, science to business (S2B), business to science (B2S), web portal.

1 Introduction

A possible and significant weakness of any academic process is the certain isolation of university science from industry's needs. When we say certain, it means that it is more or less typical for different universities and their research subdivisions, such as departments, scientific centres, and laboratories. For instance, the Ukraine, which is famous for its highly qualified industrial and scientific resources, has many positive examples of cooperation. However, overall isolation exists for various reasons.

Obviously, given the experience of Western universities, we can state that such an issue depends on location and varies by country and region. The fact is that tuition paid by the students and state financing do not rank first in the revenue structure of Western universities. The scientific work at universities in Europe and the U.S. is mainly financed by research grants, projects and consulting activities. As a result, university lecturers and instructors are required to be practicing experts in the areas covered by the courses they teach. If a lecturer is a high-demand professional, then he is typically an example for students to follow. He earns a higher income and has a more modern mentality. He also provides more interesting and informative lectures. In other words, he can talk knowledgably about work experiences.

Other countries, including the Ukraine, are experiencing significant challenges in employing lecturer-practitioners and real experts in the universities. The solution to this issue is the development of closer communications between representatives of science and industry. Such communications allow for the creation of synergy and obtaining new levels of quality.

The present paper promotes the synergy between science-education (primarily represented by computer science and engineering departments at universities) and IT industry as represented by companies that develop and supply information technologies for different applications. This pair can, and should, function as a single unit, and the goal is to propose solutions for effective university and industry interaction.

At present, the main focus is on the problem of S2B and B2S cooperation in the Ukraine as an example of a country with a history of IT outsourcing companies and with a lack of its own Silicon Valley and internal software products. The Ukraine is famous for its highly qualified programmers and scientists, but faces a set of challenges against the implementation of planned incubators or innovation centres as demanded by the government, investors, and large corporations. Mutually beneficial scenarios of cooperation between companies and universities worldwide have been proposed to cope with this issue. The idea is to develop and intensify all possible combinations of collaboration among domestic and foreign companies and universities, including international spin-offs and projects conducted by large international teams or partnerships with many members. Such collaborations will be mutually beneficial because each part makes its own important contribution, e.g., Ukrainian scientists and developers combined with European business and market experience. As one of results, primitive industrial outsourcing will be changed to advanced level of research partnerships.

A partnership between start-up companies and university spin-offs—Advanced Spin-off—is proposed as the most promising UIC model. We consider the start-up company as a small and young team of motivated developers who work mainly on outsourced projects, but who are interested in developing internal start-ups. UIC with such companies has obvious mutual advantages. Companies get previously scarce resources for internal projects. Universities (professors and PhD students) get commercial support with knowledge of the market and industry needs. The resulting common interest and successful S2B marketing mitigate the question of the required initial investments.

The real-life implementation of the Advanced Spin-off concept is a big challenge as well. However, it addresses different sets of issues that are all perceived as solvable. The main challenges encountered during the first attempt to organize an Advanced Spin-off between Sealpoint Company and the National Aerospace University (KhAI) were the absence of efficient networking and differences in team cultures of industrial developers and university researchers. These challenges are not unique to the Ukraine and are common for UIC worldwide. Many European universities do not have a systematic approach for UIC models like Advanced Spin-off. As a result, a common solution is proposed as a special web portal for general UIC networking and specifically for S2B marketing for conducting joint Advanced Spin-off projects. Requirements for such web service were gathered as a follow-up to the Workshop on Business Analysis and Project Management for Innovative Startups in Critical Domains (Dependable Systems, Services and Technologies DESSERT’12 International Conference, 2012) and are based on the networking between representatives from universities, small and large IT companies, and research and development (R&D) corporations.

This paper is organized as follows. Section II describes the existing realities and challenges of UIC based on information gathered during discussions with potential stakeholders and users. Section III provides the explanation for the S2B–B2S concept and its principles and describes the three possible scenarios of cooperation. Section IV discusses the Advanced Spin-off model in detail with lessons learned from the first case study on its feasibility. Section V provides a description of web-based networking to support Advanced Spin-off projects and UIC in general. It refers to the requirements and the prototype of a desired web-portal. Finally, Section VI presents the summary and future plans.

2 Challenges in UIC

Before we can define the S2B–B2S concept, its scenarios, and models, it is necessary to describe the current challenges of UIC to understand the motivations and trends on each side, to display existing discrepancy. The following list of realties is based on thoughts and opinions gathered from representatives of different universities (not only Ukrainian ones), outsourcing IT companies, students, and employees of large IT corporations.

(1) Ukrainian universities (after, the term "Ukrainian" can be generalized to include all post-Soviet higher schools) differ from Western ones by making the educational process more valuable than science and technology. Moreover, the teaching workload of Ukrainian lecturers and professors is representatively greater.

(2) Students from the Ukraine are usually very good in math and related subjects, but lack a knowledge of business and market strategies. This standalone thought fits perfectly with the previous one. Even software engineering is taught how it can be applied within large corporations, but not own small start-ups. This fact seems to be true worldwide.

(3) The following paradox is possible when young graduates or senior students earn more than their professors. This reality can be generalized for universities all over the world, but the issue is more topical exactly for the Ukraine and serves as additional evidence of the high discrepancy between science and industry.

(4) The following well-known fact intensifies the previous item: PhD students (even given all possible scholarships and assistantships) earn less money than those who went directly into industry and commerce. This is the reason for PhD jokes like "PhD programs, like a marriage, are usually entered into by foolish young people, but in this case instead of being "in love," they are simply without jobs" (PhD Comics, 2013).

(5) Ukrainian universities experience a lack of proper support from IT companies that usually limit this support to recruiting activities and advertisements.

(6) The Ukrainian IT industry mainly consists of outsourcing companies. R&D activities are mainly performed at headquarters at foreign sites.

(7) Top developers (like champions of programming contests and competitions) at any cost try to avoid outsourced work and get accepted at those headquarters of foreign large IT corporations.

(8) Computer science students in the U.S. are usually satisfied with work at local middle-sized IT companies, while the Ukrainian top programmers usually aimed for such famous corporations as Google, Facebook, and Microsoft. The fact we observed was that students from one American university did not know about the TopCoder service for online competition, which is very famous among Ukrainian contestants because a good ranking on it is valuable when applying to aforementioned and other large companies (TopCoder, 2013).

(9) Computer science students all over the world start their jobs early (and very productively), even during study as internships or part-time positions. It usually causes a total decrease of the quality of further education. Thus students

usually become developers of one technology, very professionally, but without a fundamental and creative approach to the problem and with a lack of research and analytical skills.

(10) Fundamental knowledge becomes highly demanded by all IT employers (whether it is a large corporation or a small start-up). Complex systems require an understanding of the whole technology. The common trend is to name job vacancies with general titles like “software engineer” instead of a specific one like “PHP developer.”

Because of the anonymous character of the abovementioned realities, we decided not to make many specific conclusions, but this list will serve as a background to the explanation of benefits for S2B–B2S models and scenarios. The only summary worth mentioning is that outsourcing interactions can be modernized for productive joint R&D projects and collaborations just by involving university science in the process.

3 The S2B – B2S Concept

In this paper, we define the concept of S2B–B2S as mutually beneficial and effective personnel, technological and scientific cooperation among university departments and IT companies, and an orientation towards the creation of competitive IT products, technologies, and services. The main principles and trends of S2B–B2S implementation are as follows:

› arrangement of interaction directly at the level of university departments and R&D laboratories

› “statutory” fixation and development of an innovative status for departments and universities as a whole

› implementation of a mutual profit strategy (win-win), accounting of restrictions and expectations of partners

› targeted involvement of youths (students, PhD students), lecturers, and doctoral candidates in joint R&D activities with IT companies

› mandatory results for dissertations on popular technologies for today or tomorrow

› the development and the implementation of organizational forms, and joint projects to bring together university and industry representatives (PhD incubatories, start-ups, workshops, trainings, and hackathons, etc.)

› vertically integrated training of personnel for different types of activities in the IT industry (developers, analytics, managers); as an example of such integration is coordinated activity (educational, contest-oriented, scientific) of university schools, departments, and IT companies

- interaction with mass media for favourable information fields
- creation of a special information resources for departments' communications (presentations of their research trends, perspective developments) and for IT companies (specification of tasks for a perspective technology's development and information about performed projects in which departments can be involved)
- search for like-minded people; authorities, universities, IT companies, and mass media should be considered not as abstract organizations but as sets of actual people
- use of elements of civil IT society (professional and public organizations working in university and industrial sectors) for lobbying support for cooperation on different levels
- maximized use of possibilities for international cooperation in all its forms; various configurations of universities and IT companies in the Ukraine and other countries

Realization of these described concepts and principles requires the introduction of scenarios for interactions between IT companies and IT departments at universities, taking into account relevant legislative support and specifics of international collaboration. The development strategy of IT branches should be clear. It can be formulated as a strategy of the balanced development of "mass" design of IT products (software, firmware solutions for different applications) for external and internal markets (with enlargement of the scope of the second one) and innovative IT technologies and projects supported by the national government or international organizations. One of the conditions and ways of realizing this strategy should be the innovative activities of universities, considered as the main factor of modernization of educational process and the economy, systematic upgrades of material and technical potential, and efficiency improvement. This leads to the necessity of changing a department's status connected with the training of IT specialists.

Scenario Description	Department Role	IT Company Role	As for Departments		As for IT Companies		As for Students	
			"+"	"–"	"+"	"–"	"+"	"–"
1) Department as a birthplace of developers	Changes curriculum and study programs to be as pragmatic as possible	Clarifies requirements for demanded technologies, provides practical and optional classes	Beneficial mass student employment	Risks of lack of R&D activity	Effective recruiting of qualified personnel	Limited personnel creativity	Quick industrial experience, clear vision of career development	Risks of lack of fundamental training
2) Department as a centre of joint work on technologies and innovations	Forms verticals (professors, PhD students, students) and develops technologies	Forms (jointly with professors) tasks for technology development	Department's contributions and achievements tied to practice	Restriction of R&D activity, increase of risks of skilled personnel loss	Profitable investment in development of R&D	Risks of business leakage and investment loss	Gaining of experience in research and deep technology	Risks of lag in others' technology skills
3) Department as a centre for entrepreneur-ship and new companies establishment (spin-offs and start-ups)	Trains IT business (jointly with companies), helps in organization of student companies inventing start-up ideas	Delegates a part of business or assists in its organization and holdings, provides consulting in business and market questions	More flexible educational process (provided by more active student participation)	Additional workload and increased requirements for professors' training	Business diversity and optimization, resources to develop internal projects	Risks of business leakage and investment loss (more than in second level)	Gaining of experience and skills in creation of own business and job	Risks of a lack of fundamental training (less than in first level)

Table 1: Advantages and disadvantages of different S2B–B2S scenarios

The efficiency of a department's innovative activities can be expressed by the replenishment of off-budget resources of the higher educational establishments, by demands of graduates, by the improvement of educational service quality, and by increase of the university's competitive ability.

Table 1 presents three main scenarios of S2B–B2S cooperation. They differ in the levels of department and company synergy, i.e., university and industry integration. In the descriptions of these levels, the focus is on advantages ("+") and disadvantages ("–") for process participants: personnel of a university department (department is a base element of the scientific and educational processes), IT companies, and students.

3.1 First Scenario of S2B–B2S

The main objective of the cooperation in this scenario is the pragmatic and mass training of personnel for industry.

The main objective of a department is the preparation of a curriculum and programs that comply highly with the needs of IT companies. In this case, training is usually targeted and "customized" for a specific company that will recruit future graduates. It is obviously necessary to get approval for the study program with the IT company as a customer.

In addition, the IT company transfers experience and technologies to the university thus participating in the educational process. Academic and teaching personnel of the universities have the possibility to deal with real operating projects and technologies, thus increasing their own professional levels.

All advanced IT companies have training centres and corporate study programs. Lecturers, who know what and why they teach, work in these centres. Another motivation for the listeners in such centres is obvious. Due to mutual interest, universities can involve such experts to present course lectures and carry out optional classes. In this regard, representatives of the universities and industry interact with each other more intensively. While communicating with students, the representatives of IT companies can select graduates and offer them jobs later.

Students can quickly enter an industry. Being preliminary informed about the specifics of their professional occupation, young experts receive optimal training.

Having many positive features, this scenario is not sufficiently flexible to respond to possible challenges. In this situation, the department can lose a part of the scientific projects because all of its resources will be involved in studying one or several technologies. IT companies will obtain well-trained personnel at the initial level, though experts might have a limited ability for career development. A serious problem consists in the risk of the insufficient fundamental training of students. Wishing to start earning money as quickly as possible, young students might miss or simply ignore important educational events, which at that time they considered them odd and unnecessary.

Obsessive pragmatism can lead to the fact that trainees are "looking around" less and appear to be strictly oriented towards a single company and technology. This risk, however, is eventually reasonable and the described scenario is more advantageous than the lack of regular interaction between science and industry. Risks can be minimized due to diversification of department activities by the optimization of balancing different forms and cooperation with various companies. In the IT industry, the training of middle- and top-rank employees can be conducted with corporate study programs.

3.2 Second Scenario of S2B–B2S

The main objective of the cooperation according to this scenario is R&D that can boost industry demand.

In this case, the department objective consists in the analysis of industry needs, perspectives of their development, and creation of research groups. Such groups allow the concentrating of resources by the formation of vertical "lecturer–PhD students–students." In this connection, orientation for scientific research for practical industry needs is realized, and industry demand for university lecturers increases.

A lecturer (professor, docent or associated professor, doctor of science candidate or person working for next degree after PhD) performs the functions of strategic management, accumulates experience in a specific R&D field, consults and communicates with IT companies, and serves as an academic adviser of dissertations written by PhD students.

PhD students are core players in the technology development ordered by a company or initiatively developed with a real implementation perspective. This work forms a frame of his or her dissertation research both in theoretical and applied senses.

Students (Master's and Bachelor's) perform practical studies, confirm technology practicability, conduct the elements of research, gain experience and participate in innovation progress within this project. On such an interaction level, the IT company jointly with the university research projects clarifies the tasks of the formation of R&D trends, thus increasing investment efficiency.

Disadvantage of this scenario from department point of view is a certain restriction of research subject, in particular, in fundamental areas due to a pragmatic character. Further training of lecturers also increases their demand on a labour market and can lead to their transition to industrial companies.

At the same time, for IT companies, the risk of investment default due to the uncertainty of expected scientific results and the possibility of their influence on business processes is also the case. There is a risk of a lag in the professional and technological skills of students due to the concentration of R&D tasks.

Like the first scenario of S2B–B2S, the risks can be minimized by diversification of department activities. The risks of carrying out science-intensive projects can be minimized by specifying the expectations and step-by-step control of the executed work.

A perspective form of cooperation in this course can be the so-called PhD-incubators (PhD– Philosophy Doctor, science degree, equivalent to Doctor of Philosophy). The main idea of such projects is the simultaneous carrying out of research on similar trends by representatives of the departments and IT companies.

The main target of the PhD-incubator is the preparation and defence of candidate dissertations by applicants, though all prerogatives, connected with the cooperation of science and industry, are true. The university applicant receives feedback from industry, and the industry applicant receives scientific support of his tasks, hence both obtain and implement competitive and called-for scientific results.

3.3 Third Scenario of S2B–B2S

The most advanced form of cooperation between science and industry is a level where science impacts technology development as well as being a place of product development and even business models in industry. It should be noted that for many Western universities, this has already been realized. For the Ukraine, such a situation is an ideal university model, hoping to be realized in the nearest future.

Within this scenario, the idea is the establishment of so-called entrepreneurship centres on universities and departments with the aim of independent economic activity intended for systematic receiving of profit. The main result of an entrepreneurship centre's operation is the commercialization of knowledge in the form of the creation of specific companies, called Spinoff-Startups.

A spin-off is understood as the establishment of companies at universities and departments for the purpose of the retrieval of additional (possibly episodic) profit from the implementation of the results of scientific research and innovations, including in the form of consulting, into industry.

The start-up concept is rarely realized in universities because the aim of such an activity is the creation of an innovative product or service with a predictable commercial success.

Besides the tasks formulated above, in such a cooperation model, a department, in fact, performs the function of business school in which representatives from both science and industry obtain the possibility to study IT business with an opportunity to establish their own companies. In this case, the educational process is organized according to a flexible system with the active involvement of students. This cooperation model certainly hinges, first of all, on the human factor, as it requires the ultrahigh qualification and devotion of the teaching personnel. However, costs are covered by a high level of material and professional growth.

The task of the IT company is to help on mutually advanced terms in the organization of IT companies at universities and departments. In this case, all risks connected with business delegation occur and therefore a cooperation model should be thoroughly regulated. However, risks can be compensated for by prerogatives from the development and scaling of business.

In this case, students receive all prerogatives from a synergy of scientific, industrial, and business-oriented activities, where each can try their skills in any role and afterwards choose a trend that suits their taste. A certain misbalance between study courses can be compensated for by the individual formation of content and a rate of passing study programs.

4 The advanced spin-off model

Obviously, all scenarios of S2B–B2S cooperation are important to develop, but the third scenario is the most advanced and innovative one. It represents the highest level of UIC effectiveness, and provides the development of IT industry with a deep research basis. All possible disadvantages for departments and students are not severe and can be avoided with proper implementation (e.g., by providing technology training for professors and requiring fundamental knowledge for students). Additionally, such S2B–B2S cooperation helps universities to deal with the aforementioned internal problems without the need for government support.

The next question that appear is how to engage IT companies to participate in such a kind of UIC, how to explain benefits, and mitigate the risks of business leakage and investment loss. For middle-sized companies, such cooperation naturally seems risky, especially if they have strong international partners and set up businesses. The main interest for them is just to obtain more students-developers.

This paper proposes the model of UIC, named Advanced Spin-off, which implements the third advanced scenario of S2B–B2S and makes synergy mutually beneficial. The distinctive idea is to cooperate with start-up companies by engaging them to support university spin-offs. Within the Ukraine, there are a lot of start-up companies, rather small and young teams of motivated developers who work mainly on outsourcing projects, but are interested in development of internal start-ups. At the same time, there are a lot of international start-up companies that are interested in additional resources for innovative internal projects. UIC with such companies has obvious mutual advantages. Companies get resources that usually are not available for internal projects. Moreover, they get resources with ability to perform R&D solutions. Universities (computer science departments) get commercial support with knowledge of the market and industry needs. Both professors and PhD students get excellent technology training and experience. At the same time international nature of cooperation can bring great base and ease search for such desired mutual supplements.

Advanced Spin-off is a lightweight UIC model according to the advanced scenario of S2B–B2S and is aimed to be its initial phase. Spiral nature of development will engage larger companies, organizations, international corporations, government, etc. Advanced Spin-off is the most promising model because the resulting common interests and successful S2B marketing mitigate the question of the required investments. It means that large amounts of investment from start-up IT companies are not needed. It is enough to split the profit of a successful and commercialized spin-off, i.e., some joint project. Students/professors will be involved in universities anyway, but in case of such cooperation, their educational/research projects can become real-life projects with benefits. We emphasize the term “spin-off” because the same model can be considered in a simplified way as a support of university spin-offs by IT companies with consulting, technology, professional developer resources, promotions, etc.

The remaining part of this section describes a case study of Advanced Spin-off implementation. There was an attempt to organize Advanced Spin-off cooperation between Sealpoint Company and the National Aerospace University (KhAI) as a follow-up for the work of the Workshop on Business Analysis and Project Management for Innovative Startups in Critical Domains (BASiC) starting from the DESSERT 2012 (Dependable Systems, Services and Technologies DESSERT'12 International Conference, 2012). The following main challenges were met during discussions with representatives of Sealpoint and professors and students from National Aerospace University KhAI (Department of Computer Systems and Networks): the absence of efficient networking and differences in team cultures or world-views of industrial developers and university researchers. The first one means that a lot of discussion is needed to obtain a single vision on a project (task) between the representatives of industry and science. For instance, scientists are sceptical about possible joint projects because they believe IT companies can suggest only pure technical problems. This is not true for two reasons: (1) the best part of IT projects starts from feasibility investigation and (2) a lot of R&D projects are present on IT market, but start-up companies have to reject them because of the lack of researchers (and sometimes of resources to guarantee fundamental approach and quality). Moreover, joint projects are possible, even in critical domains, if we consider examples of young successful companies like the SpaceX (2013) and programming competitions with real-life research problems like the NASA Tournament Lab (NASA, 2013). A solution is needed to provide efficient networking that mitigates the discrepancy between science and industry world to avoid stereotypes, misleading, and misunderstandings.

The second issue, "obstacles in team culture," augments the first one and means that professors and students behave differently than developers in IT companies, i.e., they require another treatment during the software engineering process. Industrial project managers are used to working with executives and motivated developers with full sets of supporting technical skills (e.g., version-control and issue-tracking systems), but students and professors can be again sceptical about a project's aims and less aware about the development process. A solution is needed to provide efficient networking for the establishment of single motivation and single vision on the process.

The proposed common solution is a special web portal for UIC networking that aims to provide efficient discussion and collaboration on project ideas and process organization. Requirements and prototype implementation of such a resource are described in the next section.

Figure 1: Possible motivations to use ASN web portal

5 Web-based networking

This section discusses requirements for an Advanced Spin-off Networking (ASN) web portal. The two main goals of the web service are (1) to organize exchanges of ideas and discussions of possible joint projects between university and industry and (2) to provide a workspace for specific collaboration. The idea to create an ASN portal was inspired by an Advanced Spin-off model of synergy, but it can be used for any variants of UIC and not necessary IT-oriented. Figure 1 shows possible motivations of targeted stakeholders and users of the portal: students, professors, start-up, and even large mature companies. Initial requirements for an ASN web resource were gathered based on discussions with representatives of these groups. The list of desired functionality is a follows:

(1) *Posting of project ideas with different levels of access to description and details*. This functionality is similar to different freelancers' web resources (Freelancer, 2013), but project descriptions should be more developed.

(2) *Browsing of project proposals and ability to discuss them publicly and privately*. Browsing should be supported by developed system of filters, e.g., search by type of participants wanted (i.e., developers or researchers), search only through projects with commercial funding, etc.

(3) *Ability to create development team for the project with correspondent workspace*. Each team should consist of participants accepted by the owner of the project idea.

(4) *Workspace should be supported with functions to exchange documents and other project artefacts*. The goal is to create a central place to post all materials and links related to the project and to provide base features for team discussions and process management. During attempts to organize an Advanced Spin-off between Sealpoint and National Aerospace University KhAI, we faced insufficiency of popular cloud storage services (Dropbox, 2013;

Google, 2013) because of the complex need to separate access roles, keep versions and distinguish changes in documents made by different users, etc.

(5) *Ability to position yourself and to develop own profile.* Additional goals of the resource are to promote successful projects, collaborations (teams), and members. Each member should be identifiable by a role: student, freelancer-developer, freelancer-researcher, representative of a department or representative of a company, sponsor-investor, etc. Some roles should be verified.

(6) *Integration with social networking and similar resources.* ASN web portal should be integrated with successful popular web resources like professional social networks (LinkedIn, 2013), source code repositories, and workspaces (Assembla, 2013), or even contest platforms.

The whole desired functionality results in the conceptual website map presented on Figure 2. It shows seven main tabs that provide end users with the functionality of advanced project proposals browsing, publishing of own projects, browsing through other users and team, editing own profile, operation with messages, etc. Users can create teams working on one or several projects. Each project is supported by its own workspace that should centralize scheduling and planning, discussions, configuration management, and even commercial agreements. Additionally, public members and team profiles with statistics in portal usage should serve as good portfolios.

Sealpoint team in collaboration with computer science students from National Aerospace University KhAI is developing the prototype of the ASN web portal (Sealpoint, 2013). Thus the portal creation is an example of an Advanced Spin-off project and indeed is the first practical attempt of such cooperation. Besides, we are planning to add web resource by a set of techniques to carry out assessment of both sides and make decisions regarding choice and implementing of the optimal model for cooperation.

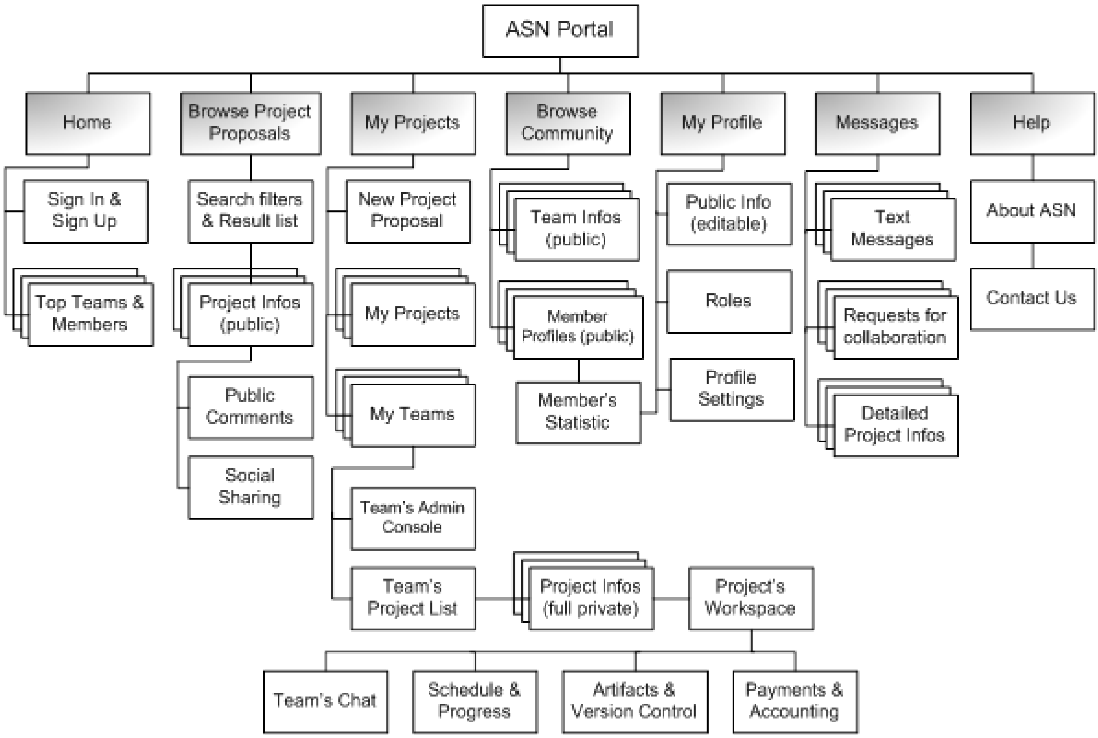

Figure 2: Conceptual site map for ASN web portal

6 Conclusions and future work

Modern science and industry are inconceivable without the evolution of innovative technologies. University science has a significant potential to organize and guide this process. This paper discusses S2B–B2S interaction scenarios. Suggested methods only specify a direction and require an overall redevelopment, i.e., for their implementation and improvement and a lot of time and effort may be required. Their choice depends on a target of cooperation of a specific university with a certain company. All scenarios depend on the human factor and being sensitive to the individual peculiarities of each of interaction entities. A positive feature is the experience of Western universities, showing that a further reproduction of partially implemented models is performed by graduates for whom the cooperation of science and industry is of a great value.

Further steps of developing interactions between science and the IT industry will be oriented for the development and implementation of the specified models and principles, which may be considered as a course of top-level action. Thus some mentioned scenarios of cooperation were already worked out during the cooperation between the Department of Computer Systems and Networks National Aerospace University KhAI and RPC "Radiy." The Centre for Safety Infrastructure-Oriented Research and Analysis (2013) was created to perform research, development, and verification support. Another example of empirical UIC is a series of TEMPUS projects involving several European universities and other facilities (Boyarchuk et al., 2011; Kharchenko and Phillips, 2009;

Volkoviy et al., 2011). Among specific questions that could be interesting for further discussion, from the authors' point of view, are the following:

› analysis of experience of the described principles and models S2B–B2S, and their in-depth analysis

› analysis and development of forms of international cooperation of universities and the IT industry (different configuration variants: national and foreign universities and IT companies; forms of project financing and co-financing, types of projects)

› analysis of peculiarities of realization of models for commercial and critical applications, taking into account their different business models, etc.

The Advanced Spin-off model of S2B–B2S was defined as the most effective initial form of UIC, and greatly scalable to international cooperation. The existing challenges of its implementation were mentioned and a web-based networking was proposed as a solution. The desired ASN web portal was described for S2B marketing and general UIC. Such a web resource is assumed to evolve according the principle of concentric circles, involving new participants, countries, continents, and obtaining additional functionality demanded by new collaborations.

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Impacts Of Entrepreneurship Education In Brazilian Students Impressions

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Abstract

This study aimed to identify impacts of entrepreneurial education in students impressions about their entrepreneurial intentions and skills in one of the most recent and distinct initiatives in Brazil, the entrepreneurship and innovation course at Fluminense Federal University (UFF), first semipresential course of its kind in Brazil. It was carried a field research with two groups of participants from the course, students who are completing or have completed the course and students who started it in 2012. The survey was conducted between July and August 2012 and combines two previously applied methodologies, one based on the Theory of Planned Behaviour of Ajzen (1991) in order to identify the impressions about student's entrepreneurial intention and its predictors and the other methodology aiming to collect impressions about students self-evaluation related to skills frequently associated with entrepreneurs. Impressions were collected using a 7 level Likert scale and the averages obtained were compared. The questionnaires were completely answered by 211 students, 54 of these completing or already completed the course. Internal consistency tests in itens related to the entrepreneurial intention variables showed that the the measures obtained in the graduate group were cohesive in all items, unlike the beginners group who in some items did showed sufficient cohesion in order to characterize a variable. Also, the correlation and regression tests revealed that the sample haven´t reflected the model in both groups. The comparison between the averages revealed some differences. In Items related to the entrepreneurial intention model, impressions regarding to the capacity in express entrepreneurial behaviour was significantly higher in the graduate students. Regarding to students perceptions about their entrepreneurial skills among the ones listed, the group of graduate showed a higher perception in some items only, the "ability to work and contribute to the organization's goals" and in "creativity". Results show first that in the graduate group the impressions about entrepreneurial intention an its predictors are consistent enough to characterize the variables, which doesn´t occur in beginner's group. Second, the results show that the graduate group have higher impressions about their capability to run a business, to contribute to an organization and in their creativity. It´s difficult to attribute these results exclusively to the participation in the course, but the results reflects some of the approaches presented in the course, starting a discussion about its contributions. Finally, a long-term study is recommended, in way to have more consistency conclusions.

Keywords

Entrepreneurship, Education, Impact, Impressions.

1 Introduction

Today, the entrepreneurship vision, the general ability to perceive opportunities in the environment and engage oneself in initiatives in order to take these opportunities for gains (whether economic or otherwise) is seen as a beneficial attitude to the community stimulate and encourage the growth of the economy, creating jobs and stimulating innovation. Due to this, institutions, governments and society invest in initiatives to encourage and promote this in society.

Many of these initiatives, based on the belief that the skills and entrepreneurial behaviour can be absorbed and taught, invest on entrepreneurial education as a way to make individuals and society more entrepreneurial. The first initiative of this kind was in 1947 (Katz, 2003; Kirby and Ibrahim, 2011) and, since then, entrepreneurial education has evolved significantly in quantity of courses offered, in methodologies developed and targeted audiences.

Following the evolution of entrepreneurial education, studies about the real effects of these initiatives are being executed following these initiatives. These studies seek to identify measure and demonstrate the effects of entrepreneurial education, justifying the investments as well as the continuity of these initiatives. The literature reveals that the effects investigated vary, but shows also that in general research about these impacts are focused on questions about the power of entrepreneurial education to encourage students to start their own business and about the incorporation of entrepreneurial skills. Is it important also to say that many of these studies are based on students impressions about their skills and intentions, wich must be considered when interpreting the results.

Given the importance of entrepreneurship awareness and the adoption of entrepreneurial education as a tool to promote these values in society of, this study will concentrate on assessing the impact of entrepreneurship education in students impressions at one of the latest initiatives of entrepreneurial education, the Entrepreneurship and Innovation course at the Federal Fluminense University, Niterói, Brazil.

In this objective, the study first summarizes the entrepreneurship evolution since the first studies until nowadays. Then, entrepreneurship education is presented, showing its definitions, development, impacts associated according to the literature and the methods adopted to do it. Based on this, the methodology of the field research is presented, justified and described. Finally the impressions collected from the students about their entrepreneurial intentions and skills are presented and analysed, which provides elements to conclusions.

2 Literature review

2.1 Entrepreneurship

Entrepreneurship can be tracked since ancient Greece, where business activity promoted independence, social and economic reforms, but the term “entrepreneur” have its origin at military French history in 17th century, used to refer to that ones who used to conduct military expeditions (Neto, 2001; Cunningham; Lischeron, 1991). The therm was first used in economic context in the same century, associated with risk taking and self-initiative (Fuchs; Wallaw, 2008). Fillion (2001) describes the evolution of entrepreneurship study since 18th century, at economics school. According to the same author, the entrepreneurship one of the precursor in this study was Richard Cantillon, who considered an entrepreneurs that one which obtain raw material for a price to resell in the future for a uncertain price (Filion, 1997; 2001). A century later, Jean-Baptiste Say starts to give to entrepreneurship a definition closer to the actual understanding, establishing the difference between the entrepreneur and the capitalist, considering the first one as a changing agent, associating, thus, with innovation (Filion, 1997; 2001). One more century later, the entrepreneurship term is more solid, thanks to few author, especially to Joseph Alois Schumpeter, considered by Filion (2001) the one who consolidated entrepreneurship as a discipline. His work associates definitely entrepreneurship to innovation and the identification of opportunities for exploring. According to Schumpeter, this capacity of create and produce wealth is the fundamental impulse which starts and maintain the capitalist engine, generating new markets, products and, means of production (Schumpeter, 1997; Degen, 1989).

Besides the economic approach in entrepreneurship study, another view about the subject considerate the behaviour feature of the entrepreneur. Gathering knowledge from psychology, anthropology, sociology and others, the central objective in this approach is to investigate the personality of the entrepreneur. According to Filion (1997) one of the first ones who investigated this side of entrepreneurship was Max Weber, at beginning of 20th century, identifying the value system as fundamental element to explain the entrepreneur behaviour, describing them as innovators, independents and leaders (Filion, 1997; Kornijezuk, 2004). However, the most significant contribution to the study of the entrepreneur behaviour, according to Filion (1997; 2001) came from McClelland, in the 70´s, identifying the “need for achievement” as the primary psychology factor to the development of the nations, associating these characteristic to the entrepreneurs (Kornijezuk, 2004). This “need of achievement” is characterized as the human willing to overcome and distinguish them, embracing psychological and behavioural characteristics as propensity to take risks, initiative, desire for recognition, responsibilities and long-term planning.

Still within the behaviour approach, but more focused in the field of social psychology, is appropriate to highlight those studies that attempt to investigate the factors that lead individuals to manifest the entrepreneurial behaviour. Many of these studies concentrate on the formation of the entrepreneurial intention. In this field of research, it is understood that intention represents the most direct preceding of behaviour and, based on this, stronger the intention, stronger is the propensity in manifest the behaviour (Fayolle et al., 2006; Ajzen, 1991). Some models of formation of intent are used to try to evidence the emergence of the entrepreneurial behaviour. The model developed by Ajzen (1991), the Theory of Planned Behaviour is one of the most adopted in literature. It tries to explain the human behaviour in specific environments based on the principle that the intention is a result of three determinants:

(1) Attitude towards behaviour - degree to which a person has a favourable or unfavourable evaluation about the behaviour in question,

(2) Subjective norm – perceived social pressure to perform or not to perform the behaviour,

(3) Perceived behavioural control - perceived ease or difficulty of performing the behaviour.

Beyond economic and behavioural approaches, entrepreneurship is also point of interest from other perspectives. Cunningham and Lischeron (1991) identified some of them, like the one, that emphasis the importance of the management capacity of the entrepreneur, the one that exalts the leadership role and the one that observes the entrepreneur inside an established organization, the intrapreneur, and other perspectives, each one with its on particularity. Finally, it is realized that the entrepreneurship study have attention from many fields of research, what makes the subject complex and broad. Rae (2010) complement this observation when says that entrepreneurship is sensitive and adaptable to other issues, like social concerns, ethical and environmental questions. A cultural movement, created and reproduced by media, political rhetoric, government actions and, the object of our study, education (Rae, 2010).

2.2 Entrepreneurship education

The first entrepreneurship course started at 1947, in the "Management of New Enterprises" MBA course, promoted in Harvard, USA (Katz, 2003; Kirby; Ibrahim, 2011). These first courses were offered as complements in the management, rarely provided by an independent department (Harmeling, 2001). Since that, with the emergency of the subject in society and its importance, de last decades saw a remarkable growth of the entrepreneurship education, especially in graduates and post-graduates. While in 1970 16 institutions offered entrepreneurship courses, in 1995 there were more than 400 (Vesper; Gartner, 1997). The United States of America have the longest tradition in entrepreneurship education, but it can be founded in many countries (Ibicioglu et al., 2008). At United Kingdom and central Europe the first courses started at the 80´s (Kirby; Ibrahim, 2011). It is possible also to find today entrepreneurship education at west Europe, Asia and Latin America, in countries like Colombia, Argentina, Mexico, Honduras, Panama, Costa Rica, Peru and Brazil (Karimi et al. 2010).

In Brazil, the teaching of entrepreneurship started 1980, when superior education institutions started to offer disciplines and courses that focused in business creation. Later, these initiatives evolved to entrepreneur's formation centers. Finally, one of the most recent initiatives at the country is object of our study, the Entrepreneurship and Innovation in Business Management, Accounting and Tourism Faculty at Fluminense Federal University. Started in 2008, this is the first entrepreneurship course offered in semi-presential format in Brazil. Characterized as a sequential course for complementation of studies, the course is open to graduating students who completed or not their course and it is offered in the city of Niterói and more 7 poles throughout the Rio de Janeiro State.

Totalling 270 hours, the program emphasis in developing skills and competences in management and entrepreneurship, combining theorical and practical disciplines related to human, business and technological aspects in 7 disciplines: (1) Creativity and Entrepreneurial Attitude; (2) Communication and Negotiation Techniques; (3) Innovation and Knowledge Management; (4) Creation and Development of Services; (5) Marketing Strategy for New Business; (6) Finances to New Business and (7) New Business Plan. This last discipline consists in a new business proposal development applying the concepts learned in the previous disciplines (Graduate Program of Entrepreneurship Management , 2012).

Considering the definitions of entrepreneurial education, we can highlight some, like the one presented by the Office of Disability Employment Policy – ODEP, that drives entrepreneurship education to youth and stats that it prepares people, especially young ones, to be responsible, to take risk, manage business and learn from the results obtained (Karimi et al. 2010). Besides, according to the same authors, the entrepreneurial education can promote a positive impression on students about self-employment. Fuchs e Wallaw (2008), bring the definition of the European Commission (2002, 2004) that establishes 3 objectives of de entrepreneurship education: (1) encourage and develop personal initiative; (2) increase the awareness and propensity to self-employment as an option to occupation and (3) transmit instructions about starting and management business. Raposo (2011), complements when differentiates the types of entrepreneurial education, education about the business – like graduate courses in entrepreneurship, to business – aiming to prepare to self-employment and on business – preparing entrepreneur inside organizations.

Finally, we can observe in these concepts some basic points about entrepreneurship education, the student capacitation about and to entrepreneurship, presenting positively this as an alternative to career and the ways to reach it. It is realized also an evolution in entrepreneurial learning concept, that goes beyond classroom and instigates the interaction of the student and its environment, the experimentation. It is valid also to remember that this wide and integrating view demands changes at the education institutions, which need to assimilate ideologically and physically in order to promote a entrepreneurial culture (Yemini; Haddad, 2010).

2.3 Impacts of entrepreneurship education

In general it is assigned that entrepreneurship education promotes benefits like business creation, promoting innovation, new jobs and local economic growth (European Commission, 2008; Millman et al., 2010).

In order to characterize the research about the impacts of entrepreneurship education, the SciVerse Scopus database (www.scopus.com) was consulted. Using the search tools provided by the portal, in December 2012 a article search was performed using terms related to “impact”, “entrepreneurship” and “education”. Analysing articles presented by the search, there were selected 32 studies that address these impacts. The articles selected date from 1997 to 2011, most of them, 19 articles, from 2010 to 2011. The studies were mostly originating from institutions in Europe (20) and 7 from USA. Regarding to the type of research, most of them, 28 articles, relate exploratory researches with quantitative methods. Mostly of the research were applied in students at graduate or post-graduate level, but other groups of students were approached in other studies like, high school students and, business owners.

Regarding to the impacts investigated, it is noted a wide range of issues addressed, singly or combined, like entrepreneurial intentions, entrepreneurial skills, business creation, knowledge on the subject and other. Though, in the articles extracted form Scoupus database we realize a concentration in some themes, 14 investigate the effect of the entrepreneurship education to stimulate entrepreneur intention, 12 the effect in entrepreneurial skills development and five address about the effects on business creation. These are the most frequent themes founded in the research, but it is noted others too, like employability, self-confidence and patent development to present some examples. This situation stresses one of the difficulties in the entrepreneurship education impacts research, the establishing widely accepted indicators (Fayolle et al., 2006).

Regarding to the results achieved in the selected articles, many of them confirm impacts of the entrepreneurial educations, but due to the wide variety of methodologies and tools adopted, it is understood that it is not adequate classify the articles based on the ones that identified impacts from the ones that do not find impacts in entrepreneurial education. However, some articles can be highlighted due to the adoption of more robust methods of analysis, like in the Sanchez (2011) study, where through correlation and regression tests identified an increase in entrepreneurial skills and intentions. Other examples in this direction can be founded in the studies of Rodrigues et al. (2010), Levie and Autio (2008), Souitaris, Zerbinati, e Al-Laham (2007). Other articles, adopting also similar methods, could not find effects in all or some aspects investigated, like in Hussain, Scott and Matlay (2010), Ahmed et al. (2010) and Oosterbeek, van Praag, and Ijsselstein (2010). These distinct results alert to an aspect that appears to be very relevant to entrepreneurship education results, the local influences. This is investigated in Levie and Autio (2008) and in Lee et al. (2006). The first one verifies the distinct relations between entrepreneurial activity and entrepreneurial education in some countries while the second one show different results of entrepreneurial education in different countries (USA, China, South Korea and Fiji). This report displays how the entrepreneurial education impact research is diffuse, with many initiatives, but distinct methods and few methods replications.

Finally, based on this characterization, it is possible to select and justifies the impacts that would be investigated at Entrepreneurship and Innovation Course at UFF, what is described next.

3 Research methodology

Considering the literature consulted, it was identified that most investigated impacts in entrepreneurial education research are the entrepreneurial intention development and entrepreneurial skills development. Following this tendency, this study focused in investigates this aspects at UFF´s course.

In this objective, there were targeted two groups of students in the course: (1) students that started the course in 2012 and (2) students who have already concluded the course or are at the last discipline of the course.

A questionarie was constructed in order to detect the impacts of entrepreneurial education in the students. It combined two methodologies extracted from the articles extracted from SciVerse to the literature review, one that aimed to identify entrepreneurial intention based on Ajzen (1991) and other that search to detect from the students their impressions about some skills to career and their self-evaluation about this skills. This elements and other are detailed next.

3.1 Entrepreneurial intention

To measure the impressions about entrepreneurial intention, it was adopted the methodology presented in Souitaris, Zerbinati, and Al-Laham (2007) based on Kolvereid (1996). This is justified by previous application and citation in other studies with success, like Ahmet et al. (2010), Zainuddin and Rejab (2010), von Graevenitz, Harhoff and Weber (2010). This methodology reflects the Ajzen´s (1991) model, based on the theory of planned behaviour which has received many attention in several studies (Fayolle et al., 2006) like in Zainuddin and Rejab (2010), von Graevenitz, Harhoff and Weber (2010), Wang e Verzat (2011) and Sánchez (2011). In the questionarie adapted to this study, in the part related to entrepreneurial intention there were 31 items related each one with one of the variables of the Ajzen´s model - Attitude towards behaviour (A), Subjective norm (SN) and Perceived behavioural (PBC) control, variables that result in Entrepreneurial Intention (EI).

In affirmatives, students should show their agree or disagree through a 7 Likert scale. The affirmatives are like “If I will, I would be an business owner easily” or “It´s very probable that I would follow an entrepreneur career”. Attitude towards behaviour measures, the items confronted reasons to be employee and reasons to be an entrepreneur in order to calculate the difference between this measures. From this measures, indexes were calculate in order to have rates related to each one of the variables and can be read as:

- AI – The higher the value, more positive impression about the entrepreneur career in comparison to the career as an employee.
- SNI – The higher the value, more positive impression about the support from the closest social circle (family, friends).
- PBCI – The higher the value, greatest the perception of the capacity to manifest entrepreneurial behaviour
- EII – The higher the value, more positive the impression about a career as entrepreneur.

3.2 Entrepreneurial skills

To measure entrepreneurial intentions acquired by entrepreneurial education the methodolgy presented in Galloway, Anderson and Brown (2005) was adapted to this study. It was select due to its objectivity and simplicity to extract student´s impressions about their entrepreneurial skills. At the questionnaire, the students were asked to, through a 7 Likert scale too, demonstrate their impressions about entrepreneurial impressions in two views. That one's understood as important too a successful entrepreneur and how that skills were in themselves. The skills listed were: Initiative, Communication skills, Organizational skills, Problem-solving ability, Confidence, Perseverance, Creativity, People management skills, Team working skills, Negotiation skills and Financial acumen.

From the description of the methodologies adopted, we advance describing the data collection procedures.

3.3 Data collection

The data collection was performed through online form provided by Survey Monkey website. (www.surveymonkey.com). Before sending to the students of Entrepreneurial and Innovation Course, the questionnaire, to test its understanding and time to response, it was answered to 10 Business Students from UFF. The students from Entrepreneurship and Innovation course were invited to participate of the survey by email, due to provision of mailing list with students addresses. The graduate student´s list contained 341 addresses while the beginner student´s list had 513. The emails were sent between July and august of 2012, except to the class that started the course at the second semester, because their mailing list was available only at august.

4 Results

The questionnaire was answered by 211 students, 54 of those declaring that had already attended the last discipline of the course, the graduate group. 92 women and 75 men (44 didn´t declared gender). The average age of the respondent was 34,33 years old, with most of them between 18 and 30 years old (51 respondents). Regarding to their original course area, 67 of the respondents come from Applied Social Sciences (35 from Business), but is also found students from Pedagogy, Geography, Engineering and others.

4.1 Validating the entrepreneurial intention model

Starting the analysis related to the impacts of entrepreneurial indication at the sample, first it will be verified the capacity of the responses reflect the variables propose by Ajzen´s (1991) model. The results will be analysed by two aspects, validity and reliability in order to evaluate consistency and stability of the measures obtained in order to reflect the proposed model (Anderson et al., 2006).

To evaluate the reliability of the responses obtained, the most common measure is the Cronbach´s Alpha, which indicates in what degree the obtained responses present a consistency indicating unity (Anderson et al., 2006). Calculating it by SPSS software, the results can be viewed at Table 1. To be considered reliable, a scale must achieve at least 0,7 in Cronbach´s Alpha Index. Considering this, we can note that most of the measurements are consistent, except for some itens, but only in non-graduate students group.

	Cronbach´s Alpha	
	Graduate	Non-Graduate
Attitude towards behavior		
Reasons to be an employee		
Security	0,919	0,782
Work Load	0,778	**0,683**
Social Environment	0,856	0,732
Avoid Responsabilites	0,937	0,821
Career Perspectives	0,927	0,901
Reasons to be an entrepreneur		
Economic Opportunity	0,744	**0,655**
Challenge	0,96	0,835
Autonomy	0,824	0,811
Authority	0,776	**0,673**
Self-realisation	0,94	0,718
Participation	0,917	0,848
Subjective norm	0,89	0,761
Perceived behavioral control	0,728	**0,513**
Entrepreneurial Intention	0,702	0,728

Table 1: Reliability Test

To evaluate the validity of the measures in order to reflect the model, it was performed the Pearson correlation test with SPSS. The Table 2 shows the results. While Ajzen (1991) model predicts that the higher the positive impression about entrepreneurial behaviour, subjective norm and perceived behavioural control, greatest the entrepreneurial intention, the results don´t reflect this correlation between the variables. The values are very close to 0 or even negative at both groups.

	Graduates	**1**	**2**	**3**	**4**
1	Attitude towards behavior	1	-,419**	0,224	,398**
2	Subjective norm	-,419**	1	-,301*	-0,207
3	Perceived behavioral control	0,224	-,301*	1	,290*
4	Entrepreneurial Intention	,398**	-0,207	,290*	1
	Non-graduates				
1	Attitude towards behavior	1	-,235**	-,204*	,335**
2	Subjective norm	-,235**	1	,178*	-0,104
3	Perceived behavioral control	-,204*	,178*	1	-,363**
4	Entrepreneurial Intention	,335**	-0,104	-,363**	1

Table 2: Correlation Test

The linear regression also don´t show a strong relation between the variables. The coefficient of determination (R2) calculated by SPSS resulted in 0,2 for both groups, showing that only 20% of the Entrepreneurial Intention variable variation can be explained by the other variables, a very low result to be considerate based on Anderson et al. (2006, pp. 458) who states that in social sciences this test have to achieve at least 0,25 to be considered relevant. Due to this, we can understand that the measures obtained at Entrepreneurship and Innovation course were not enough consistency to be reflect Ajzen´s model.

4.2 Comparison between averages

To identify differences between the results obtained in both groups, it was performed a average comparison. In this direction the hypothesis are established: (Ho) the differences between the averages of both groups is equal to zero or (Ha) the differences between the averages of both groups is different than zero. Since the sample is bigger than 30, is it possible to analyse the difference under Normal distribution precepts (Anderson et al. 2006). Therefore, to a significance level of 0,05, Ho is rejected if Z is less than -1,96 or more than 1,96. the results are show separately according to the aspect related.

	Z
Attitude towards behavior	1,1429
Subjective norm	-0,3196
Perceived behavioral control	**3,3166**
Entrepreneurial Intention	0,5673

Table 3: Comparison between Averages – Entrepreneurial Intentions

Entrepreneurial Intentions

The only significant difference identified was at Perceived Behavioural Control variable, which suggests that the impression of the graduate students about their capacity to manifest the entrepreneurial behaviour is bigger than the students that started the course in 2012.

In the first, the comparison between averages did not reveal any differences between both groups. Although, in the second item, the self-evaluation about their entrepreneurial skills revealed some differences between the groups as Table 4 Shows. The graduate group has significantly bigger averages in “Organizational Skills” and their “Creativity” items. This means at first that the graduate students have a better evaluation abou these skills compared to the group of students that started the course in 2012.

	Z
Initiative	-0,80828
Communication skills	0,696923
Organizational skills	**1,968718**
Problem-solving ability	0,534071
Confidence	0,174574
Perseverance	1,410711
Creativity	**2,1223**
People management skills	-0,96477
Team working skills	-0,35308
Negotiation skills	-0,20915
Financial acumen	0,312446

Table 4 – Comparison Between Averages – self-evaluation about entrepreneurial skills

Finally, from the results founded we can at first realize that were identified few significantly differences between the impressions about entrepreneurial intention and skills. This results will be more discussed and related with the course context later

5 Conclusions and recommendations

With the results obtained in the survey, it is adequate to connect the information collected with some aspects of the course and students in order to get relevant conclusions.

But before it, is important to remember that the evaluations obtained are impressions of the students about his capabilities and intentions. This brings a subjectivity to the measures obtained that complicate assertive conclusions. The methods of analysis try to reduce this subjectivity, but we still must consider this.

Returning to the results obtained, since we applied two type of analysis, this will be maintained now in conclusions.

5.1 Reliability and validity of the entrepreneurial intention measures

In the reliability and validity tests of the variables related to the entrepreneurial intention model, first it is noted that the internal consistency measures did not reach sufficient levels in a few items, but only at students that started the course in 2012. This reveals, at first, that the measurements obtained from this group are sparser while the ones obtained form graduate group are more cohesive, what could reveal also a greater assertiveness on this group. Despite the impossibility of affirm that this assertiveness is caused by completing the course, is interesting to note that this occurs only in this group.

In advance, testing the capacity of the measurements correlations reflect the Ajzen´s (1991) model, the results revealed that it was not reached in both groups in Person correlation test, since the Ajzen´s model predicts that there is a positive correlation between the variables. Regression test also shows that the independent variables have a very low influence in the dependent variables (Entrepreneurial Intention). Despite this measures are not directly related to the main objective of the study, this tests evidence a little about the relation of the sample with the questionnaire and the model itself. While in one hand there is internal consistency in variables, on the other hand the relation between these measurements do not reflect de what is established by the model. This could be caused by several factors like the questionnaire comprehension, the sample approached or the local culture, as was mentioned before. Beside it, the successful application of this questionnaire in other occasions somehow endorses the method.

5.2 Comparison between averages

The comparison between the averages obtained through the entrepreneurship intention and skill measures revealed few significantly differences between both groups impressions. In the variables related to the shaping of entrepreneurial intention, only in the perceived behavioural control variable, the one that measures the impression about the easiness in manifest the entrepreneurial behaviour, it is noted that the in this variable the average of the graduate group was higher. This means at first that the graduate students have a higher positive perception about their capacity in manifest the entrepreneurial behaviour when compared to the non-graduate group, they fell themselves more prepared act. It´s hard to assert that the course is responsible in this result, but is valid to remember that one of the objectives of the UFF´s Entrepreneurial and Innovation course states “afford and promote tools and concepts for several areas to a better construction of knowledge around entrepreneurship and the entrepreneur” (Graduate Program of Entrepreneurship Management (2012), what is coherent with the results.

Regarding to the impressions about entrepreneurial skills of the students, first in the item related to the impressions about the importance of entrepreneurial skills, it was not detected significant differences, but in the item related to the self-evaluation about these skills, there were significant differences in two aspects asked, ”Creativity” and ”Organizational Skills”. Relating these results with the course contents, it is adequate to highlight some of the disciplines, like the “Creativity and Entrepreneurial Attitude” that have the aim to awake in the individual its creative talent and entrepreneurial spirit (Mariano; Meyer, 2008). Advancing in the course, two more disciplines are related to creative incentive, the “Creation and Development of Products and Services” and “Innovation and Knowledge Management”. Finally, although it cannot be said that this more positive impression about these skills are caused by the course, it can be realized that this result is coherent with the course load.

Regarding to the more positive impression about the organizational skills, is it difficult to relate this aspect with one specific discipline, but it must be considered that many of them try to promote skills necessary at an organization like ”Finances to new Business” or ”Marketing an Strategy to new Business” and others..

In other perspective, it is important to note also that in some skills listed in questionnaire that were directly related to the Entrepreneurship and Innovation course there were no differences detected between the groups, like ”Negotiation Skills” and ”Financial Acumen”.

Finally, at the end of this study, it is believed that this work contributed to the research about impacts of entrepreneurial education first replicating and adapting methodologies. Beside it, the results obtained are important in order establish a broad view about student´s impressions about these extremely related with entrepreneurial intention themes and providing elements to evaluate this course. Due to this and the importance given to the subject today, is also recommended a continuous monitoring of these impressions in order to consolidate conclusions and find patterns in this and other initiative in entrepreneurial education.

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Business Model Adaptation: Are New Technology-Based Firms Different?

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Abstract

The business model is an important construct for practitioners, but only recently researchers have begun to study it. Empirical research on adaptation in particular is almost non-existent. It mostly comprises of case studies of large established firms. We contribute to the gap by creating an economy-wide longitudinal dataset of new ventures. This allows us to describe adaptation in elements of the business model in a manner that has not been possible thus far. We are also able to conduct methodologically sound tests of theory-based models. We consider adaptation to elements of the business model as a form of organisational learning and apply human capital and social capital theory to understand their role in facilitating adaptation. We split our sample in two and deploy the same analyses to firms where proprietary products and processes are relevant and to those where they are not. To test the hypotheses we conduct moderated hierarchical regression analyses on the two groups of firms. We find that social capital and generic education are significant for mainstream firms, but not firms where proprietary products and processes are relevant. The opposite is true for specific education and for generic and specific experience. We also find that the interaction between human and social capital has a different effect in the two groups of firms.

Keywords

Business model adaptation; technology-based firms; human capital; social capital.

1 Introduction

The business model is an important driver of economic performance (Malone, Weill, Lai, D'Urso, Herman, Apel and Woerner 2006; Zott and Amit 2007; Zott and Amit 2008) and is the transforming mechnism that creates market value from technology and innovation value (Chesbrough and Rosenbloom 2002; Björkdahl 2009). Understanding what factors facilitate or impede business model adaptation therefore becomes very important.

Research on the business model has moved beyond its initial focus on e-business (Mahadevan 2000; Afuah and Tucci ; Amit and Zott 2001; Weill and Vitale 2001) to other sectors such as biotechnology (Bigliardi, Nosella and Verbano 2005; Pisano 2006; Rothman and Kraft 2006; Willemstein, van der Valk and Meeus 2007). Individual studies do, however, remain narrowly focussed, as highlighted by Patzelt et al (2008: 217):

> *... we would also like to encourage business model researchers to extend their attention beyond the e-business and internet industries, on which most studies have focused so far*

At the same time, academic researchers have only conducted “embryonic work focusing on a dynamic perspective” of the business model at the firm level (Sosna, Trevinyo-Rodriguez and Velamuri 2010: 402.) Past research has consisted of case studies of large, established firms. These studies have often stated or hypothesised the distinctiveness of early stage ventures in this respect (Chesbrough and Rosenbloom 2002; Sosna et al. 2010), but there is little research on such firms. Entrepreneurship literature shows there are differences and that early stage firms merit separate study (Nicholls-Nixon, Cooper and Woo 2000 ; West and Noel 2009).

Of the few quantitative, regression-based studies on the business model (Malone et al. 2006; Andries and Debackere 2007; Zott and Amit 2007; Patzelt et al. 2008; Zott and Amit 2008; Bock, Opsahl, George and Gann 2012), two make use of adaptation/innovation.

First, Andries and Debackere (2007) used business model adaptation as predictor of survival of new technology businesses in the United States. Their database (the annual CorpTech directory) contained two elements of the business model: product and target market. As a result, the adaptation variable was based on researchers noting changes in product/market descriptions. Any other forms of adaptation were therefore not observed.

Second, Bock et al (2012) use adaptation as a moderator between structural reconfiguration and structural flexibility. The latter study included one equation with “business model innovation” as dependent variable, finding that leadership involvement was a significant driver. It is, however, based on the 2006 IBM Global CEO Survey, with only 33% of the sample having 0-5,000 employees (Bock et al. 2012: 286).

Other quantitative studies have generally been sectorally based, aimed at describing typologies of business models (Mangematin, Lemarié, Boissin, Catherine, Corolleur, Coronini and Trommetter 2003; Bigliardi et al. 2005; Willemstein et al. 2007). Because of their biotechnology focus, these studies mostly consisted of young firms, but not exclusively so. Further, the phenomenon of adaptation was not the focus of research.

To fill that gap, this paper reports on a panel study of young and nascent firms discovered through a large scale random survey of households (Davidsson, Steffens, Gordon and Reynolds 2008). Because of the broad nature of the study, we can make comparisons between the mainstream and firms for which proprietary processes and products are relevant (hereafter we use the shorthand: IP-relevant firms.)

A further contribution stems from our methodologically sound longitudinal observations, which allows us to make causal inferences (Scandura and Williams 2000; Martinez 2011). In this paper we therefore take an organisational learning perspective. That is, we take business model adaptation to be a reflection of the new firm’s learning. We then apply the theory of human and social capital to ask the question: what is the role of human capital and social capital in business model adaptation for mainstream new ventures and for IP-relevant firms.

The paper proceeds as follows. First, we review relevant literature to explicate why we might expect to see differences between the two groups and why human and social capital should impact on business model adaptation. Then, we outline our method and present results. This is followed by a Discussion of implications for theory, practice and further research.

2 Theory and hypotheses

2.1 Distinctiveness of high technology markets

When the business model acts as the transformation mechanism between the science/technology domain and the market domain, then it is subject to uncertainty and dynamism from both domains (Chesbrough and Rosenbloom 2002.) The cognitive difficulties are exacerbated in science-intensive ventures by the fact that the technological uncertainty remains higher for a longer portion of the product development process (Malerba and Orsenigo 2002; Pisano 2006.)

In a similar context, Eisenhardt and Martin (2000) cursorily referred to business models in their analysis of the distinctions between moderately dynamic and high-velocity markets. In the former environments, firms are reliant on existing knowledge and orderly procedures, could more readily identify market participants, and displayed clearer business models. In the latter environments, they state that market boundaries, market participants and business models are more fluid and unpredictable. Here, Eisenhardt and Martin (2000) find that dynamic capabilities need to be based on few rules, mostly in order to set limits or priorities for knowledge search and creation, because existing knowledge is likely to be counterproductive in the rapidly shifting conditions (McKelvie and Davidsson 2009).

While it seems clear that one could have placed business model adaptation within the dynamic capabilities framework given existing definitions, more recent contributions to the field (Teece 2007; Augier and Teece 2008) make the connections explicit, from a logical, theoretical perspective, as evidenced by this passage:

> *"The capacity an enterprise has to create, adjust, hone, and, if necessary, replace business models is foundational to dynamic capabilities." (Teece 2007: 1330)*

In highly dynamic technology-based environments, market participants learn from each others' experiments, as well as from their own. They take small continuous steps in the business model adaptation process (McGrath 2010). These assertions about business model adaptation in high technology markets are typically hypothesised, but not tested systematically. This study reports data that allow us to test the hypotheses that

H1 IP-relevant firms engage in more business model adaptation than the mainstream

2.2 Organisational learning, social capital and human capital

The developmental approach of the organisational learning literature sees organisations taking a pro-active learning attitude, as in the dynamic capabilities literature. It theorises that learning changes in manner and content, based on age and size (Sinkula 1994), as well as history of the organisation (Cohen and Levinthal 1990; Shane and Venkataraman 2000). New ventures must rely more on ”congenital knowledge” which is then developed through trial and error in the marketplace (Sinkula 1994: 38).

Human capital is both an important driver and recipient of organisational learning. It comprises the accumulated stock of knowledge from certified and experiential learning (Arrow 1962; Brown and Duguid 1991). Generic human capital can be applied across domains with low switching costs and loss of returns (Becker 1964; Reed and De Fillippi 1990). Specific human capital is less easily transferred, precisely because its value is more specific to particular settings.

Previous studies have found that prior stock of knowledge allows learning to occur from new information and the uneven distribution of such stock across the economy impacts on how the information is processed and on entrepreneurial outcomes (Shane 2000; Davidsson and Honig 2003). These higher cognitive abilities should also facilitate business model adaptation.

H2 Greater generic human capital in the form of education and experience will lead to greater business model adaptation in new ventures

H3 Owners' greater specific human capital in the form of education and experience will lead to greater business model adaptation in new ventures

Social capital can enhance organisational advantage through its effect on learning (Brown and Duguid 1991; Nahapiet and Ghoshal 1998) especially for managers "with few peers" within the firm (Burt 1997: 345). This is the situation often found in new ventures struggling with the liability of newness (Stinchcombe 1965). We distinguish between bonding and bridging ties.

Bonding ties occur when there are high levels of camaraderie and trust, such as in families, or among friends (Becker and Murphy 1992; Cope 2011). Information flows rapidly, and there is strong positive reinforcement of behaviour (Sobel 2002), which can lead to excessive reliance on internal communication hence impede adaptation (Kautonen, Zolin, Kuckertz and Viljamaa 2010). Bridging ties connect individuals to networks with which one has fewer interactions, where the sense of common purpose is more diffused. Information flows tend to be slower, but can reach out more broadly making them a more useful means of collecting and disseminating novel ideas and practices (Rogers 1962). Useful bridging ties can accelerate learning especially when markets or technologies are uncertain (Teece 1996), or the young firm has limited accumulated human capital (West and Noel 2009). Hence:

H4 With greater component of family and friends in the new venture founding team, business model adaptation will decrease

H5 Greater use of network connections of the bridging type will lead to greater business model adaptation, with diminishing returns

We can therefore see the important impact of prior human capital embodied in the firm, typically mostly in the owner-founders. This can them be augmented and reshaped through social capital activities that draw in new data and information to interact with existing resources. Past research hypothesises complementarities between human and social capital (Nahapiet and Ghoshal 1998; Ployhart and Moliterno 2011). It follows that their interaction should also have an impact on business model adaptation. Therefore, we hypothesise

H6 There is a stronger positive relationship between bridging social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

H7 There is a weaker negative relationship between bonding social capital and business model adaptation for those with high levels of human capital than for those with low levels of human capital

We do not hypothesise relative importance of social and human capital between the two groups of firms (IP-relevant and mainstream), expecting to infer any differences from the empirical results. This is because, while we might expect higher levels of human capital in IP-relevant firms, distinctions within the groups might be important drivers of variance for mainstream firms (Unger, Rauch, Frese and Rosenbusch 2011).

3 Methods

3.1 Source of data

Data are drawn from the Comprehensive Australian Study of Entrepreneurial Emergence (CAUSEE) which adopts a methodology developed by the Panel Study of Entrepreneurial Dynamics (PSED) (Gartner et al. 2004; Reynolds 2007). Telephone contact of a random sample of 30,105 households in Australia, generated 1,186 new ventures in its first wave (Davidsson et al. 2008). Interviews were conducted repeatedly over four years. In wave four, 382 respondents were asked questions about their firm's business model.

This design deals with two important sources of selection bias: sampling from an incomplete population (Martinez 2011); sampling on the dependent variable (Denrell and Kovács 2008). It allows temporal separation of dependent and independent variables (Scandura and Williams 2000) and varied question type in a long interview (Podsakoff, MacKenzie, Lee and Podsakoff 2003), in a theory-based model. Thus, our design aids inferences of causality.

3.2 Measures

In order to distinguish the firms for which technology or innovation are relevant, we asked two questions about intellectual assets. We asked if any applications to protect intellectual property had already been submitted, would be submitted, or was not relevant to the business. We also asked if the business had developed proprietary technology, processes, or procedures that no other company can use, if it would do so in future, or if it was not relevant for the business. The latter question was important, because there are innovations for which formal protection is of little value, or could even be detrimental. Innovative processes and software are typically not protected through patents. In dynamic environments, the cost and time required for formal protection might not be a useful investment compared to rapid creation and exploitation of innovations or discoveries.

From these two questions, we created a dichotomous variable for firms that considered technology and innovation relevant/irrelevant to their business. In this study we use the variable created from answers in wave 1.

3.2.1 Dependent variable

Our interviews covered four elements of the business model: product, customers, method of promotion, method of production. In waves 2-4 we also asked about adaptation of those elements:

> *For each of the following statements I would like to know whether there has been any important change during the last 12 months and, if so, roughly how many changes there have been of that kind. [emphasis in original]*

Possible answers ranged from No/0 to Yes/5+. To generate an overall picture of business model adaptation, we aggregated the number of changes for each element of the business model.

For our descriptive analysis, we dichotomised the aggregated responses into a Yes/No variable. If they had made changes, respondents were then given a list of potential reasons and asked how many changes were due to the specific potential antecedent. The reasons are listed in Table 3. For our regression analysis, we drew our dependent variable from the answers to wave four. The raw data were then augmented by 1 and a log-normal transformation taken.

3.2.2 Independent variables

Human and social capital were operationalised using variables for each theoretical category (ie generic/specific, bridging/bonding.) Some are formative measures (Leonard-Barton 1992) combining several items in the database, as a count index of the relevant components (McKelvie and Davidsson 2009). Others are single item measures. Observations were mostly taken in wave one, with some from wave two.

We asked questions about the ownership team's collective generic experience: years of general management experience; whether anybody had worked in management in a large corporation for more than a year (dummy variable); number of countries in which all owners had either worked or studied as an adult for a period greater than three months. Our measure of *generic education* is the percent of owners with postsecondary qualification.

Questions relating to the ownership team's collective specific experience asked about: number of years in the same industry as the current new venture; number of prior start-ups created. We constructed an index to capture how the firm's prior work experience was useful to the new venture. In wave 2, we also asked whether employees or other paid helpers had made important contributions in the same areas, during the previous year. Similar variables have been labelled Business Skills Index (Haber and Reichel 2007) or comprehensiveness of knowledge (Sullivan and Marvel 2011) but generally denote a larger stock of human capital, the higher the index count. To measure specific education, we asked whether any of the owners could help the business in certain areas, based on their education and training.

We adopted one measure of bonding ties and two of bridging ties. Bonding ties typically relate to family and close, long standing connections (Davidsson and Honig 2003; Cope, Jack and Rose 2007). We asked respondents if any owners were related by marriage or blood, were friends from work or social environments, or were strangers.

Important forms of bridging ties consist of connections in networks that are explicitly business related (Davidsson and Honig 2003). We have adopted this method and created a global social capital index counting membership of face-to-face and online business networks, industry groups/associations, as well as aspects of international activities. We sought information about possible sources of information and advice that had been "not used at all; a minor source; or a major source" [emphasis in original]. To compile this external advice index, we listed fourteen potential sources, ranging from employers or colleagues to customers and business media.

As controls we used: age of the youngest and oldest partners; proportion of female partners in the ownership team; a product/service dummy.

3.3 Statistical procedure

We applied a non-parametric test to the data about whether the firms had made any changes to their business model. Otherwise, we report absolute levels and percentages for the descriptive data on changes of individual elements of the business model and on reasons for changes.

We conducted the analysis in seven models. This was to obviate multicollinearity problems (Chandler, McKelvie and Davidsson 2009). Before testing for interaction effects, we centered the variables on their mean (Jaccard, Wan and Turrisi 1990). We then entered into the moderation step of the regression a cross-product of the hypothesised predictors and moderators (Frazier, Tix and Barron 2004). In the equations testing for moderation effects, all variables are centered on their mean.

In order to test hypotheses 2-7, we ran hierarchical multiple regression analysis. Controls, human capital, social capital, and interaction terms were entered as separate steps in the models.

4 Results

4.1 Descriptive data

Table 1 displays the number and percentage of firms that implemented any adaptation to their business model in each wave. On each occasion, the firms that in wave 1had considered IP to be relevant were more likely to have adapted their business model. The χ^2 statistics show that the split between change/no-change in the two groups was significant in each wave: H1 is supported.

	W1		W2		W3		W4	
	N	%	N	%	N	%	N	%
Intellectual property relevant								
No change	141	25.7	103	32.0	87	38.2	72	42.4
Some change	408	74.3	219	68.0	141	61.8	98	57.6
Total	549		322		228		170	
Intellectual property not relevant								
No change	250	39.4	191	48.8	136	48.6	112	52.8
Some change	384	60.6	200	51.2	144	51.4	100	47.2
Total	634		391		280		212	
Crosstab χ^2	25.14***		20.72***		5.53*		4.15*	
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$								

Table 1: Change/No-change distribution, Waves 1-4

When we examine the various elements of the business model (see Table 2) we find two consistent patterns. First, the ranking is the same across waves. Products are the element most likely to be adapted, followed by customers, promotion or selling methods and finally production or sourcing methods. Second, the IP-relevant firms were more likely to have made changes to each element, in each wave.

A tabulation of reasons given for the business model adaptation is in Table 3. We present only data for the IP relevant firms, to save space. In each wave, the top two most frequent reasons driving adaptation were success with customers and internal drivers for innovation. The internal driver was most popular in wave 1 and customers in waves 2-4.

	Number				% of respondents			
	W1	W2	W3	W4	W1	W2	W3	W4
Intellectual property relevant								
Products or services that you sell or intend to sell	284	147	81	66	43.3	45.7	35.5	38.8
What customers you sell to or intend to sell to	206	115	80	55	37.9	35.7	35.1	32.4
The method for promoting or selling	206	108	67	51	37.7	35.5	29.4	30.0
The method for producing or sourcing	180	78	60	33	32.9	24.4	26.3	19.4
Intellectual property not relevant								
Products or services that you sell or intend to sell	227	123	75	50	35.9	31.5	26.8	23.6
What customers you sell to or intend to sell to	188	111	67	51	29.7	28.4	23.9	24.1
The method for promoting or selling	180	91	55	47	28.4	23.3	19.6	22.2
The method for producing or sourcing	142	57	47	35	22.4	14.7	16.8	16.5

Table 2: Type of change, Waves 1-4

Intellectual property relevant	Number			% of respondents		
	W1	W2	W3	W1	W2	W3
Customers requested change	194	91	54	35.7	28.3	23.7
Market research suggested change	224	103	55	41.1	32.0	24.1
Suppliers suggested the changes	132	43	34	24.1	13.4	14.9
Funding opportunities or investors suggested it	114	45	20	20.9	14.0	8.8
Had to make changes because of lack of funds	135	56	35	24.8	17.4	15.4
Changes to the management team triggered changes	89	36	27	16.2	11.2	11.8
Success with a customer refocused your effort	247	139	86	45.1	43.3	37.7
Failure with a customer refocused your effort	128	70	46	23.4	21.7	20.2
A partnership with another business encouraged changes	109	53	35	19.9	16.5	15.4
Internal interest in a new innovation led to changes	248	119	73	45.3	37.1	32.0

Table 3: Reasons for change, Waves 1-3

Intellectual property relevant vs Intellectual property not relevant	χ^2, significance		
	W1	W2	W3
Customers requested change	15.5***	ns	ns
Market research suggested change	31.8***	10.5***	3.8*
Suppliers suggested the changes	ns	ns	ns
Funding opportunities or investors suggested it	7.0**	5.5*	ns
Had to make changes because of lack of funds	5.0*	ns	ns
Changes to the management team triggered changes	3.8*	ns	5.3*
Success with a customer refocused your effort	ns	3.1†	ns
Failure with a customer refocused your effort	ns	ns	ns
A partnership with another business encouraged changes	11.5***	14.2***	ns
Internal interest in a new innovation led to changes	34.5***	15.8***	8.4**
† $p \leq .10$; * $p \leq .05$; ** $p \leq .01$; *** $p \leq .001$			

Table 4: Reasons for change, Waves 1-3, Crosstab χ^2 and significance

Table 4 presents results of non-parametric tests, in which we crosstabulated reasons for business model adaptation against the two groups in our analysis. Whenever the Pearson chi-squared statistic was significant, the IP-relevant firms displayed a higher percentage of the particular reason being reported. Success with a customer was the most highly reported driver for both groups, but the incidence between groups was only marginally significant in wave 2. Changes to management was generally at the bottom of the rankings for both group of firms, but its impact on business model adaptation was significantly different between the groups in waves 1 and 3. Similarly, business partnerships were relatively lowly ranked by both groups, but their impact was significantly different in waves 1-2.

4.2 Hierarchical moderated regression analyses

Phase two of the study involved running hierarchical moderated regression, which is the appropriate statistical tool to test interaction terms. We present the regression results in Table 5. Due to space constraints, we do not show coefficients for each variable. Rather, we report the change in R^2 for each step of the hierarchical regression and its statistical significance.

Intellectual property relevant							
	Social Capital	GenEducn; GenExp	SpecEducn SpecExp	GenEducn * SC	SpecEducn * SC	GenExp*SC	SpecExp*SC
Controls	ns	.06†	ns	.06†	ns	ns	ns
Social Capital	ns			ns	ns	ns	ns
GenEducn		ns		ns			
BusEducn			.06**		.05**		
GenExp		.06*				.06*	
Spec Exp			.07**				.10***
GenEducn*SC				ns			
BusEducn*SC					ns		
GenExp * SC						ns	
SpecExp * SC							.10†
Model R^2/ $AdjR^2$	.09/.04	.12/.07	.18/.13	.12/.04	.13/.05	.24/.11	.30/.18
Total Model *F*	1.73†	2.38*	3.77***	1.44	1.64†	1.86*	2.49***
N	167	165	166	166	167	166	166
Intellectual property not relevant							
Controls	ns	ns	ns	ns	ns	ns	ns
Social Capital	.12***			.12***	.12***	.12***	.12***
GenEducn		.02*		.ns			
BusEducn			ns		ns		
GenExp		ns				ns	
Spec Exp			ns				ns
GenEducn* SC				ns			
BusEducn* SC					ns		
GenExp * SC						ns	
Spec Exp * SC							ns
Model R^2/ $AdjR^2$	.16/.12	.08/.04	.05/.00	.18/.12	.17/.11	.20/.11	.24/.14
Total Model *F*	4.09***	2.01*	1.08	3.06***	2.82***	1.96**	2.39***
N	211	209	211	211	211	209	210
† $p \le .10$; * $p \le .05$; ** $p \le .01$; *** $p \le .001$							

Table 5: Moderated hierarchical regression analysis

In the first three columns, we report the direct effects of: social capital; generic education and experience; specific education and experience. Moderation hypotheses are tested in the following columns. The controls were not significant, but the product/service dummy was significant, with negative sign (ß= -.24, $p \le .05$) indicating that product firms made more changes than service-based firms. Social capital was insignificant for IP-relevant firms. It was highly significant for the mainstream ($p \le .001$): global social capital (ß = .16, $p \le .001$); external advice (ß = .03, $p \le .01$). H4 is not supported, but H5 is partially supported.

The second model tested the significance of generic human capital. For IP-relevant firms, generic education was not significant, but the step consisting of generic experience variables was significant. The opposite was true in mainstream firms. For IP-relevant firms, general management experience was marginally significant with negative sign (ß = -.01, $p \leq .10$), whereas the other variables were both significant and positive: experience in large corporations (ß = .31, $p \leq .05$); work or srudy abroad (ß = .04, $p \leq .05$). Although the step was not significant for mainstream firms, experience in large corporations was, with positive sign (ß = .24, $p \leq .05$). General education had a positive impact (ß = .003 $p \leq .05$). H2 received partial support.

Specific human capital was tested in the third model. Both the education and esperience steps were significant for IP-relevant firms, but neither was significant for mainstream firms. For IP-relevant firms, same industry experience was significant and negative (ß = .-.01, $p \leq .05$), firm work experience was significant and positive (ß = .06, $p \leq .01$). H3 is supported for IP-relevant firms.

None of the steps containing interaction steps were significant for mainstream firms, but for IP-relevant firms the interaction between specific experience and social capital was marginally significant. Looking more closely into those steps, we find significant interaction effects for mainstream firms between: large corporate exerience and external advice (ß = .06, $p \leq .05$); firm work experience and external advice (ß = -.01, $p \leq .05$); same industry experience and external advice (ß = .06, $p \leq .05$). We also find two significant interaction variables for IP-relevant firms: same industry experience and bonding ties (ß = -.39, $p \leq .01$); firm work experience and collaboration (ß = -.13, $p \leq .01$). There was partial support for H6 and H7 in the mainstream. For IP-relevant firms, the significant interaction terms had the opposite sign to what was hypothesised.

In order to understand better the nature of the moderation in these variables, we ran simple slope plots with high and low levels of the items within the interaction terms. We took high and low to be ± one standard deviation from the mean. First, we present the plots for IP-relevant firms.

Figure 1 shows the plot of business collaboration on business model adaptation for different levels of firm work experience in IP-relevant firms. As the experience variable is a dummy, we took readings at 0 and 1. In IP-rich environments, the relationship between business collaboration and business model adaptation is positive when the focal firm has low levels of prior relevant work experience. The relationship, however, turns negative when the firm embodies higher levels of prior relevant work experience.

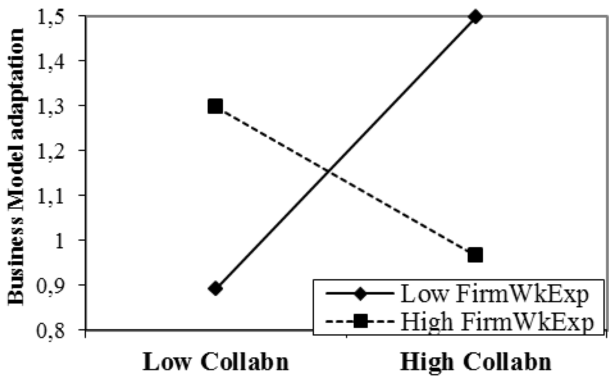

Fig. 1: Plot of business collaboration on business model adaptation for different levels of firm work experience in IP-relevant firms

In Figure 2 we plot of bonding ties on business model adaptation for different levels of same industry experience in IP-relevant firms. Again, the relationship switches from positive to negative as this specific human capital increases.

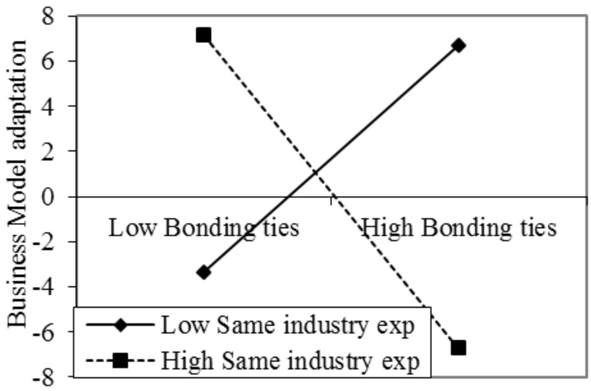

Fig. 2: Plot of bonding ties on business model adaptation for different levels of same industry experience in IP-relevant firms

Next, we present simple slope plots for mainstream firms.

Figure 3 shows the plot of external advice on business model adaptation for different levels of same industry experience in mainstream firms. It indicates that the relationship between external advice and business model adaptation is negative when the firm embodies a low level of same industry experience, but turns positive at higher levels of same industry experience.

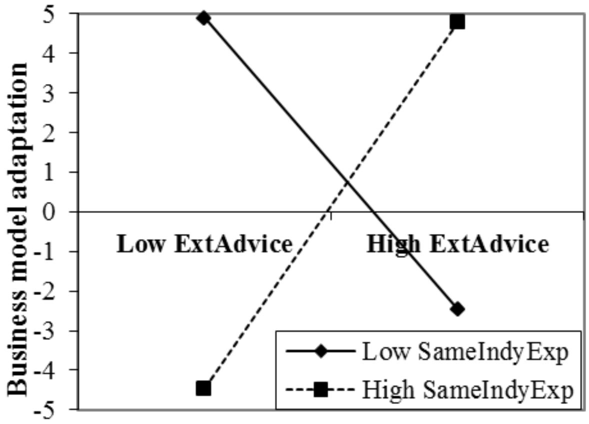

Fig. 3: Plot of external advice on business model adaptation for different levels of same industry experience in mainstream firms

Figure 4 displays the plot of external advice on business model adaptation for different levels of firm work experience in mainstream firms. It indicates that the positive relationship between external advice and business model adaptation is stronger at lower levels of firm work experience.

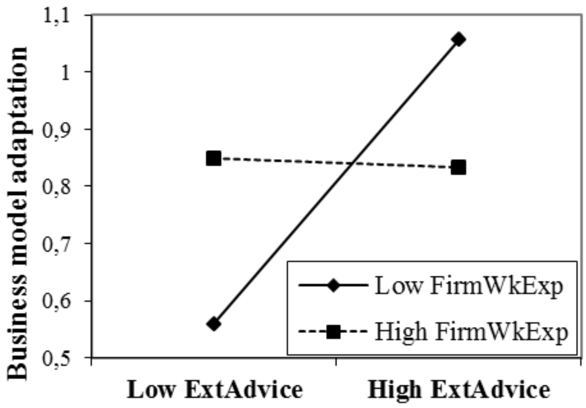

Fig. 4: Plot of external advice on business model adaptation for different levels of firm work experience in mainstream firms

In Figure 5 we show the plot of external advice on business model adaptation for different levels of experience in large corporations. As the experience variable is a dummy, we took readings at 0 (no experience) and 1 (experience.) The plot shows that, as the firms seek more external advice, those with experience in large corporations increase their adaptation more than those.

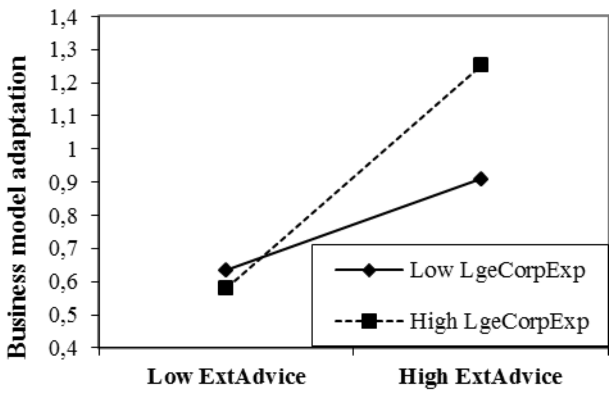

Fig. 5: Plot of external advice on business model adaptation for different levels of large corporate experience in mainstream firms

5 Discussion

Both the descriptive and inferential statistics suggest there is a difference between technology-based new firms and the mainstream. Firms for which intellectual property is considered relevant in business terms are more likely to adapt their business model and to do so continuously.

The descriptive data show that for all firms customer interaction is an important driver of business model adaptation. Success with a customer – a form of organisational learning - was consistently the most highly ranked driver of adaptation. It does not, however, relate differently across the two groups of firms. Consistent differences across waves were found in the importance of market research and on internal interest in innovation. Overall, this suggests that the quantity and quality of internal resources has a relatively greater impact in IP-relevant firms.

The results of our inferential tests are consistent with this. Whenever a step was significant in one set of firms, it was not in the other. Thus, social capital was significant for mainstream firms, but not for IP-relevant firms. On the other hand, most of the human capital steps in our regressions were significant for technology based firms, but not for the mainstream. This does not mean that mainstream firms engaged more in networking. Our IP-relevant firms displayed higher mean levels on each measure of social capital and the differences were statistically significant (p = .000 for all of the bridging ties.) Within each category of firms, however, the different level of networking was differentially associated with business model adaptation.

Average levels of human capital were higher for our IP-relevant firms, and the difference statistically significant ($p \leq .002$) on each measure except for years of management experience and for same industry experience. Experience-based human capital appears to be useful for business model adaptation in IP-relevant firms. Business-specific education also seems to be useful. That is possibly as a complement to the technical education that would often be embodied in firms that are strong in technology or innovation.

For mainstream firms, having a greater presence of general education is associated with greater business model adaptation. This might reflect a greater openness to new ideas or an ability to make connections across disciplines of areas of activity.

It should be noted that the confidence intervals for individual variables do overlap to some degree between the two groups of firms.

In very broad terms, the interaction of human and social capital does not add much to the adjusted R^2 for mainstream firms but it does for IP-relevant firms. When we delve more deeply it appears that external advice is moderated by different forms of human capital, but not uniformly so.

An important implication for both theory and practice is that different sources of learning have a comparative advantage in different contexts. Thus, we need to achieve greater granularity in our theorising and empirical investigations of both social and human capital (Dimov and Shepherd 2005; Stam, Arzlanian and Elfring 2013). Similarly, practitioners (ie entrepreneurs, advisers, technology transfer offices, policy makers) should approach business model adaptation differently depending on the circumstances of the focal firm: mostly networking for mainstream firms; mostly developing human capital for firms in technology- and innovation-rich markets.

6 Conclusions and recommendations

New technology-based firms are different.

They engage in more and broader business model adaptation than the mainstream. This is driven more from their human capital than their networking, although the social capital is enhanced by interacting with the human capital.

The design of our study affords high population validity for new ventures in Australia and allows causal inferences, which is rare in business model research. Generalisation to other economies, however, would require replication of the approach taken here. The Global Entrepreneurship Monitor or similar initiatives would be valid.

Our findings suggest there are useful research topics in understanding how networking occurs, the role of boundary spanners and the reasons for different interactions between human and social capital. Contingency theory, configurational perspectives, or related frameworks (Ginsberg and N. 1985; Venkatraman and Ramanujam 1986; Johns 2006; Dimov 2007; Unger et al. 2011; Stam et al. 2013) hold scope for valuable insights into the research task of understand the business model and business model adaptation. They in turn will benefit from the contributions emanating from business model research.

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Frameworks And Tools For The Coordination Of University-Industry-Government Collaboration

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Abstract

These days, universities, business entities, and regional governments have become very active in fostering University-Industry-Government (U-I-G) collaboration toward the national, regional and industrial innovation.

For example, it becomes popular for a university to have an office specialized for industry liaison and community engagement, for industry to take open attitudes to university as a potential partner in their business development, and for governments to implement various policies to promote those interactions between university and industry. And we all have understood that there should be some coordinating works to make those interactions happen, and that to be a coordinator there means not only to be a good messenger but also to be a good facilitator in general.

However, it seems that there are rather few frameworks and tools which one can employ in thinking and acting to be a good coordinator.

There are a lot of academic studies related to UIG collaboration, starting from knowledge-economy development, innovation management, and science & technology policies to technology transfer, business incubation, and of course UIG collaboration. Especially these years, some books have given us very good understandings or conceptual perspectives of UIG collaboration. Also many examples and data of UIG collaboration activities have been accumulated worldwide and become available for us to refer, in addition to those positive attitudes and activities offered by all of U, I, and G.

In spite of these progresses both in studies and in available resources, what-to-think and how-to-think to decide practical coordination activities have been still left largely for each coordinator's discretion. Coordinators can either look up resources eagerly offered by U, I, and G and the accumulated cases of collaboration, or study the perspectives of UIG interaction. But then, they need to go without any practical guidelines for on-site's daily activities.

Working in the area of UIG collaboration for about 15 years, the author has developed several frameworks and associating tools to give a coordinator some of these guidelines in UIG coordination. Those frameworks and tools have been somewhat verified through practices and discussions with practitioners and researchers in Japan and in some developed and developing countries.

These frameworks and tools can neither provide a final solution nor be useful in every cases, because these are just generalized patterns basically induced through real situation and are not fully verified with absolute logics. Depending on differences among topics, cultures and other circumstances, these frameworks and tools should be modified, or should be used in an improvising way.

However, through our experiences of considering an UIG collaboration system in a region, in a country, or between countries, we have understood the benefit of having some generalized and structured frameworks and tools. These could be a good starting point to explore the differences among cases and to have

appropriate modification, and provide us a wider view in understanding UIG collaboration and its coordination.

Keywords
University-Industry-Government collaboration; coordination among multi stakeholders; frameworks and tools; "how to think" and "what to think" in coordination.

1 Introduction

One of the key approaches to foster the national, regional and industrial innovation is to effectively utilise the University-Industry-Government (UIG) collaboration, and this approach has been largely planned and implemented worldwide. In Japan, since late 1990's, the government has implemented several policies to foster the UIG collaboration, along with a series of the Science and Technology Basic Plans. Especially over these couple of years the directions toward "science & technology for the society" and "regional innovation" has become much stressed. Stimulated by this governmental movement, universities and regional governments have become very active in collaborating toward innovation together with industry. These days, for example, it becomes popular for a university to set up an organizational system for industrial liaison and community/regional engagement, and on the other hand industry becomes rather open to university as a potential partner in their R&D and business development. And central and regional governments have been trying to set up appropriate supports along with policies and those activities.

In this situation, we are to be reminded that there are a variety of situation for UIG collaboration, therefore, open mind and wider perspective is essential to promote it. UIG collaboration is a multi-stakeholder situation, where partners with different backgrounds and different purposes are working together for co-evolution, and you need to seek for win-win-win situation.

Obviously, a coordinator should be here, in order to cover this wider and more general situation than specific researches and businesses, and the coordinator is apparently required to have capability of not only a good messenger but also a good planner/facilitator/operator. In a sense, he/she needs to know how to be a good mover & shaker. And, since situational, cultural and social differences affect largely on the way of being a good mover & shaker, the coordinator needs to have a good capability of understanding and utilising the situation in a practical sense. Then, how can a coordinator get the capability to understand surrounding situation and utilise it for the action plan in next steps? This is the issue being addressed in this paper.

As discussed in Section II, conceptual perspectives of UIG collaboration such as its dynamics and meanings have been already studied and discussed a lot, and related practical information has been widely accumulated and available. Also coordinator training has been there but the focus is basically to provide elements of required knowledge in

UIG coordination. This paper addresses the issue of UIG coordinator's "what to think" and "how to think" in converging those perspectives, information, and knowledge elements toward the specific topic at hand, by providing a set of frameworks and checklists for the purpose, as described in Section III (overall structure) and in Section IV (detailed descriptions). Application of these frameworks and tools are discussed in Section V, and conclusions and next steps are in Section V. (Another important issue to facilitate the coordination is "how to act" to be a good mover & shaker, but this is not discussed in this paper.)

In this paper, "framework" is defined as a comprehensive and structured set of items, while "tool" is defined as less comprehensive, less structured, but useful list of items to be used along with a framework.

2 Current situation of the issue

The issue addressing in this paper is, as described above, what could be the practical ways that a coordinator can employ in his/her daily activities in understanding and thinking of the situation for a specific topic at hand. What are they?

There are a lot of publications by academics related to UIG collaboration, from the perspective of its meanings and dynamics, as well as of its relevance to knowledge-economy development, innovation management, science & technology policies, business incubation, etc. Especially over the past several years several of them (especially Etzkowitz, 2008; and some others) have given us very good conceptual picture of UIG collaboration.

Also much practical information, such as case studies, events, policies, and related data have been accumulated and become available for us to refer to. For example, we can get a variety of information on UIG collaboration at homepages such as: "Sangaku Renkei no Michishirube" ("Signposts for U-I Collaboration") by JST in Japan; "consortium EuKTS" by EuKTS in Europe; "Knowledge Transfer Portal" by RCUK in UK; and "Government-University-Industry Research Roundtable" by National Academies in USA.

In addition, each university and business has prepared many systems to introduce their open attitudes as well as specific topics of interest toward the outsides, in forms of exhibitions, seminars, databases, newsletters, dialogue sessions, and so on.

As a whole, a coordinator can now look up rather conceptual perspectives and a breadth of related information on UIG collaboration. What a coordinator should do is to understand those perspectives and information, and integrate them with his/her own knowledge, expertise and experience in business, research, IP, project and such effectively for a specific UIG coordination topic to decide what to do in coordination, as shown in Figure 1.

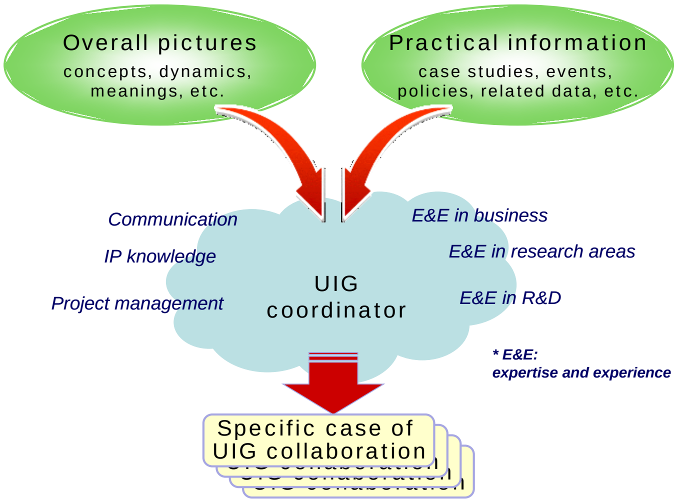

Figure 1: UIG Coordinator's Role

In spite that there are a wide reference of conceptual perspectives and practical information, "what to think" and "how to think" of coordinating specific collaboration topics have been still left largely for each coordinator's discretion. There are training seminars for UIG coordination, and a wide variety of knowledge, including intellectual properties, governmental policies, business management, trends in specific research areas, and so on are taught. UIG cases are studied. And exercises are conducted with real and virtual situation. So we can get elements of required knowledge, and opportunities to utilise them together with his/her expertise and experience. However, as far as the author has checked, little training have been conducted with generalized but structured guidelines of "how to think" and "what to think" of these knowledge and expertise. It seems that these guidelines fail to be recognized its importance both by academics and practitioners, and fell in the middle of a gap between those two types of UIG specialists.

3 Overall structure of frameworks and tools

When a coordinator is little experienced, for example, he/she might put too much focus on product development and fail to realize the professor's benefits in research or to recognize collaboration opportunity in human resource development. To assist UIG coordinators to think in a simple and effective way, various frameworks and tools have been developed by the author who has worked in the area of UIG collaboration for about 15 years, partly as a UIG practitioner at university and regional government sides, and partly as a programme developer and lecturer of UIG coordinator's training programmes.

These frameworks and tools have been used in the practices and in training, and then aligned into the thinking phases of UIG collaboration. Based on experiences, the author has understood these phases as shown in Figure 2.

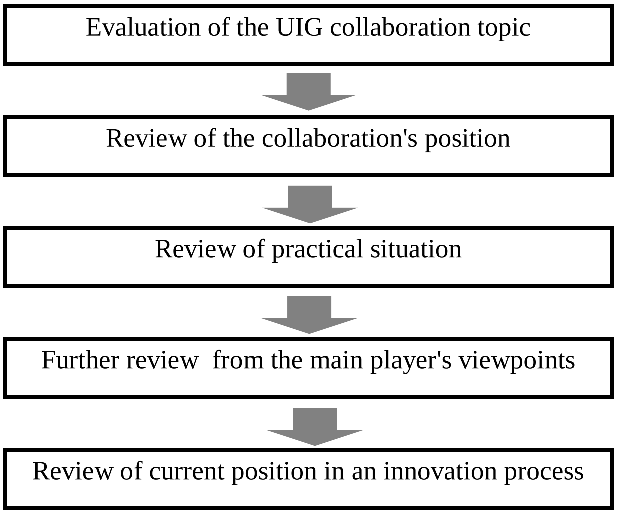

Figure 2: Thinking Phases

These phases basically constitute a top-down approach, except the last one, by starting from general and overall evaluation of the whole UIG topic and its position, to a very specific situation for the main player's viewpoint. Approach from the bottom (i.e., a specific situation for the main player) is also possible. However, because UIG collaboration is a situation where generally three stakeholders or more with very different backgrounds are working together, an effort to grasp the situation with wider horizon would offer the thinker (i.e., the coordinator) an opportunity to realize and position those stakeholders in a same picture, and makes it rather easier for the coordinator to recognize the things to be considered further and to think of priorities among them in an earlier stage. The last framework in the process, MECI Cycle, is to review the overall UIG situation from a much wider perspective of innovation. This framework is rather to conduct a conceptual review, than to obtain practical implications for coordinator's activities.

Process	Frameworks
Topic Evaluation	• Initial Evaluation Framework
Positioning of the collaboration	• UIG Collaboration Framework
Practical situation	• Five Perspectives of UIG Collaboration
Situation from main player's viewpoint	• Project Description Chart
Overall situation as an innovation process	• MECI Cycle

Table 1: Thinking Process and Frameworks

Along with these five phases, frameworks listed in Table 1 are offered. These frameworks are somewhat overlapped and mutually complementary to some extent. And some of them look like just a set of common senses. However, the real value of these frameworks resides in these explicit expressions, and each of those phases could be employed independently or together. Details of these frameworks are explained in Section IV.

Also, there are several checklists organized as supporting tools for those frameworks, based on the author's experience and expertise, and on other references. Among them, frequently used ones are listed in Table 2, and some of them are explained in Sub-section F in the following section.

- List of possible reasons for promoting UIG collaboration; for U, I, and G
- List of potential players; for U, I, and G
- List of possible UIG collaboration forms; for U and I
- List of possible resources offered by U, I, and G.

Table 2: Supporting Tools for the Frameworks

4 Details of frameworks and tools

In this section, the detailed description of those five frameworks, including the contents and how-to-use, are provided. Some of the supporting tools listed in Table 2 are also shown and explained.

4.1 Initial evaluation framework

This framework is to evaluate the topics of UIG collaboration in a simple and consistent way, initially from a wider perspective, so that this works as a guideline to give a coordinator an initial opportunity to exercise thinking from different standpoints, at the same time as an initial checklist to go further or not. For example, when a coordinator is given a topic of an UIG collaboration, then he/she can go through this framework, using already known information and collecting unknown one from other players and also from some experts. The evaluation cannot be a perfect one, but it is important to go through this framework at least once in order to understand which points are already clear and which are not.

The framework consists of three values, all of which has three checking points as shown in Figure 3.

1. Value of the topic itself
   Novelty : **new? existing? how different?**
   Reliability : **verified? reproducible? just ad-hoc?**
   Practicability : **workable with reality? only in a dream?**
2. Value for the society
   Potential to make the life easier or more comfortable?
   Potential to solve the society's issues?
   No potential to be a threat or an issue for the society?
3. Value for the concerned entity
   Potential to make the entity happier?
   Potential to solve the entity's issues?
   No potential to be a threat of an issue for the entity?

Figure 3: Initial Evaluation Framework

4.1.1 Value of the topic itself

The topic itself, whether it is a new idea of product, regional development, or research advancement, is to be checked out of its values, not for any specific entity but in a general sense. This evaluation can be achieved by checking out three points; novelty, reliability, and practicability of the topic.

The first point, novelty, is a necessary condition. If you are thinking of "motor technology for electric bicycle" and the technology itself is new, it means the checking goes well. Or, even when the technology itself is an existing one, it would be OK if other situation, such as the company applying the technology to electric bicycle, is a new and non-conventional one. The point here is to think of "what point in the collaboration can be new" for a given specific condition. Reliability should be checked from research viewpoints, from main player's and the topic proposer's background, from past cases of similar situations, and so on. Practicability is also checked by looking at similar situations in the world and history. All of these three points are to be satisfied altogether, and the most important point here is to run through the topic's characteristics, though roughly, from a simpler but wider points of view.

4.1.2 Value for the society

Value for the society is also a necessary condition, but all three points here need not to be satisfied simultaneously. The first and second points are mutually related to like two sides of a coin, because the first one is to get more positive effect and the second is to get neutral effect out of negative situation. At least, once one of these two is sufficiently evaluated, the other can also be described in a sufficient way. Third point for the threat and issues for the society is certainly a necessary condition.

This evaluating point should work well especially when a coordinator or a main player/proposer is too hot and too focused on the topic. This can be an initial exercise of an out-of-the-box thinking, by widening the perspective toward regional community, society, or the whole earth.

4.1.3 Value for the concerned entities

These values here are not of a necessary condition at this point, and in later phases of Thinking process (Figure 2), such as with Five Perspectives and Project Description Chart, the coordinator will be again asked to check these. If your evaluation of the second value, "value for the society" above is checked sufficiently, then you must have someone or some entities happy or comfortable.

The most important point in evaluating this value is first to think of as many concerned entities as possible, and second to think of who would be the most benefitted and most negatively impacted entities. This point is mainly to make the coordinator to have initial exercise to think from various stakeholder's' standpoints in a consistent way.

4.2 UIG collaboration framework

This framework is to position the topic in a comprehensive UIG collaboration picture. As shown in Figure 4, this framework is a simple chart constituting university's offering expertise, "education", "research", and "others", and beneficiary of the collaboration. In the "others" category of the chart, university's offering expertise includes; administrative activities such as for social responsibility; student recruitment; student's volunteering works; space and facilities; cultural events and entertainments; and so on.

		University's offering expertise		
		Education	Research	Others
beneficiary of the collaboration	society in general			
	community / regions			
	industry			

Figure 4: UIG Collaboration Framework

When UIG collaboration (though in reality that was UI then) started widely being discussed in Japan in late 1990's, the focus of collaboration was mainly on collaborative R&Ds, that is, the most topics then were concentrated in the bottom middle of the chart. When the importance of Management of Technology education became big in our policy in following years, topics of collaborative education had became popular with increasing number of topics around the bottom left of the chart. Because of political suppots in regional cluster development in early 2000's, the collaborations considering the benefit for community and regions in the upper level became popular. And these days "Science and Technology for the society" and "university's social engagement" are widely discussed and implemented in U, I, and G's activities, the collaboration looking at the benefit of the society is also becoming popular, with growing number of topics in the top-most level and in the right side of the chart.

Therefore, now, topics in any positions in the chart could become a coordinator's responsibility. And it is crucial to position a topic in the chart because depending on the position, corresponding ministries and policies, as well as corresponding organizations in universities and companies, are different. So that, without understanding the difference, a coordinator cannot identify contacts he/she should talk to, while once the topic can be positioned rightly in the chart, a coordinator can look up the similarily positioned potential partners and policies, such as shown in Figure 5, for more appropriate approaches.

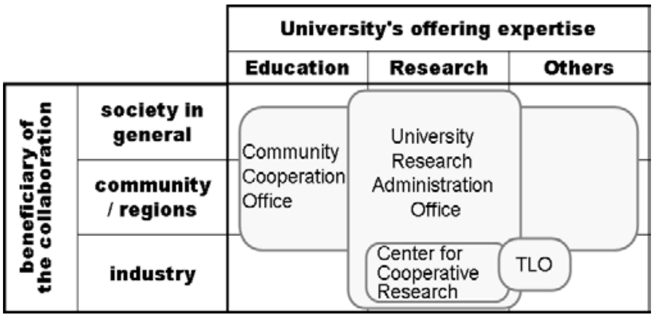

Figure 5: Kyushu University's Organization

4.3 Five perspectives of UIG collaboration

This framework is for practically reviewing a overall concept and situation of UIG collaboration. Having checked the topic itself and its position through previous phases with the two frameworks, now the practical situation as a whole is to be checked using this framework shown in Figure 6. These five perspectives consisit of the reason and backgrounds (Why), the stakeholders and players there (Who), available resources (What), the main beneficiaries out of the collaboration (by Whom), and the overall scheme of it (How).

1. WHY the UIG collaboration is to be promoted?
2. WHO acts on the UIG collaboration?
3. WHAT resources are there?
4. By WHOM the benefits of the UIG collaboration are to be gained?
5. HOW the UIG collaboration be structured?

Figure 6: Five Perspectives of UIG collaboration

For example, even when it looks that a company purely wants to have a collaborative development with a professor, it might be that in reality the company wants to get a governmental UI collaboration fund and to have an academic partner just for the fund application. A coordinator of course should take this situation into consideration. Or, even when a coordinator has understood a regional government's positive attitude toward UIG collanoration, this positive attitude might be caused by labor shortage in engineering, a plan to promote a specific industry, or a necessity to improve local water quality. In order to take an appropriate and effective action in coordination., it is important for a coordinator to check these reasons and backgrounds.

For this "Why" perspective, there are typical reasons and backgrouns of UIG collaboration, and also for "Who", "What", and "By Whom", there are sets of possible options. A coordinator should understand the real one among them, or the whole collaboration activities would be misled. To check these options, checklists of "possible reasons of UIG collaboration" and "potential players there" have been prepared and available as shown in Table 2.

4.4 Project description chart

This framework has been developed for describing situation of a project and business development for a specific player, especially for the main player in the UIG collaboration. Therefore, this is generally called "Business Description Chart", as in Sato (2012). However, the name of "Project Description Chart" is used here just to avoid misunderstanding from the term "business".

With this framework shown in Figure 7, comprehensive dynamics of the project can be shown for an at-a-glance review.

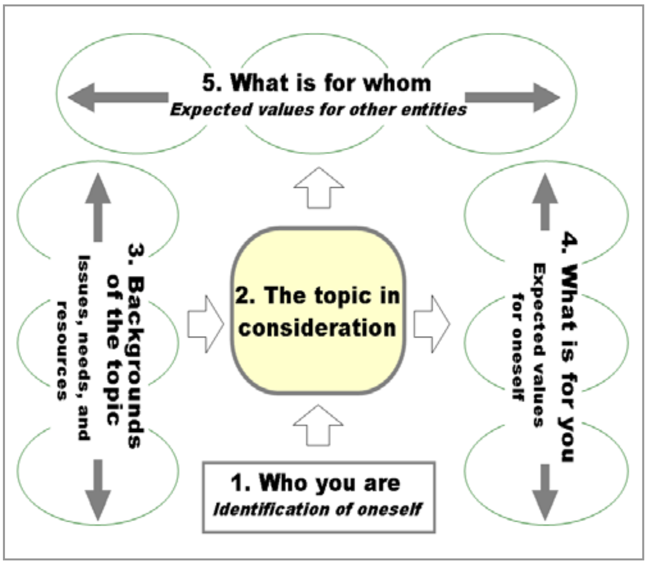

Figure 7: Project Description Chart

By starting consideration from "who you are" and a concise and explicit description of "what the topic is", to the benefits of the main player and of those who are concerned, you can clarify the whole picture of the project at hand and see which points to be reconsidered.

This framework is structured as a working chart with blank squares and ovals. In practice this is used to describe what a coordinator has understood and assumed in each blank spaces, then to discuss and review the whole picture and inconsistency among each descriptions. In most cases, this leads to re-describing the chart in a clearer and more balanced way.

Through this back-and-forth process, a coordinator can have another opportunity to review what he has understood using the previous frameworks from a little different viewpoints. Also, this process provides a coordinator with more explicit understandings of; what is the real purpose of their topic; what they have understood and not understood in relation to the topic; on which point they have the strongest urge to go forward; which points to be verified further with facts; and so on.

Also, describing whole situation in a plain expression is also very important in any project, because a project could not be achieved without some others' involvement, and it is also a necessity to share the situation among those who are involved together with you. This chart, with blank squares and ovals in a page, is to force a coordinator who is working on this to think of as concise understandable expressions as possible.

The five parts of Project Description Chart are described below.

4.4.1 Who you are (Identification of oneself)

This part is to identify onerself, the coordinator or the main player in this case, with relation to the topic in consideration. It is rather easy to talk about the whole situation in general terms like a critic. However, trying to grasp the practical situation of onrself is a necessity if you are really after the right value creation. There should be big difference among situations where you are a coordinator affiliated to a university, a independent coordinator working for project fee, or, you are a coordinating officer at the regional government. By writing this part and reviewing the whole picture later, a coorfdinator is spontaneously reminded of these differences.

4.4.2 The topic in consideration

At the center of chart, this round square is to describe the topic in consideration, i.e., describe what a coordinator is going to coordinate, or a purpose of UIG collaboration. Again, understandable but concise descriptions are desirable. For example, descriptions such as "collaborative R&D of a new material" or "HRD for industry" may be written at the beginning, and though these are concise they are not sufficiently precise. These descriptions would be re-written repeatedly for more concise and precise ones, in correlation with the descriptions in other parts of this chart, and we might finally get descriptions such as "collaborative R&D of a new material for biodegradable syringe", or " HRD for the region's smart community development".

4.4.3 Backgrounds of the topic - issues, needs, and resources

In the left side of chart three ovals are prepared, to describe backgrounds of the topic. In other words, what has made, makes, and would make it possible for you to pursue the project at the center should be described here.

As the background reasons of the collaboration, we have already checked a variety of situations, both of the main player's/coordinator's own and of circumstances, with the Five Perspectives framework above. Also, in general, the situation can be checked in two directions. One is to consider the main player's features, missions, current issues,. and the other is to check social/economic environments such as explicit needs of the topic, relevant issues, related policies, market situation, etc.

Sometime, in describing this left side, one may find that he/she has understood only his/her own passion as the business backgrounds. It is OK, because then, the necessity to check other situations described above can be clearly understood. Depending on the results of these additional checking, the topic at the center needs to be re-considered. This is the real meaning of this working sheet..

Once you have a list of those situations, then you need to consider the priority among them, to pick up the most important three out of them. Again, the three ovals are there to force a coordinator, to think clearly and concisely, but in a wider perspective and in a practical sense.

4.4.4 What is for you - expected values for oneself

The right part of the chart is to describe expected values for the main entity, generally a coordinator or his affiliated organization. It is to be noted that, here in this chart, already described three part, "who you are", "the topic in consideration", and "backgrounds of the topic", may sometime rather specify the expected values more in detail.

4.4.5 What is for whom - expected values for other entities

The top part of the chart is to describe expected values for other entities. The values, along with who would receive each of the values should be described in these ovals.

Here again, we can use what we have considered for "Value for the society" and "Value for other entities" of the Initial Evalution Framework. Also, in this chart it is important to prioritize those values and the receiver (beneficiary) of those values considering the whole picture. Also, when "the topic in consideration" is revised it may provide other values to other entities.

Figure 8 shows an example of descriptions in Project Description Chart.

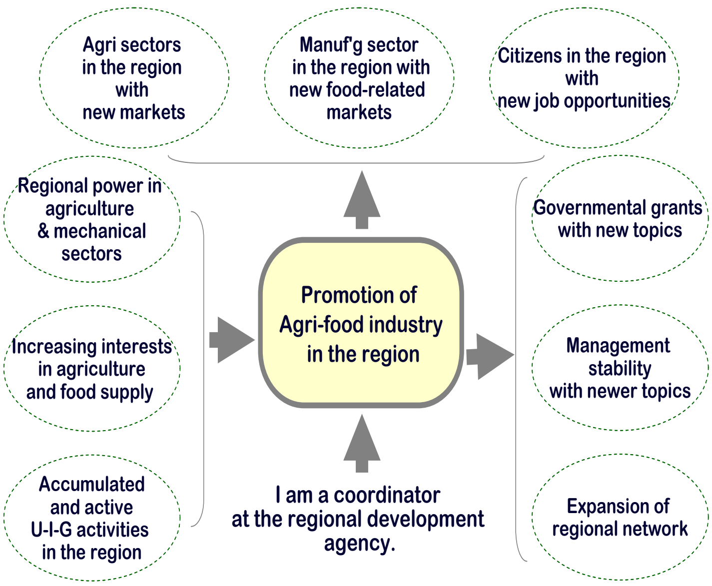

Fig. 8: Example of Project Description Chart

4.5 MECI Cycle

This last framework is to review the whole UIG situation from rather conceptual viewpoint of innovation process.

A concept of "meta-engineering" has been proposed by a task force in the Engineering Association of Japan. as dynamic engineering approach to innovation, as shown in Figure 9. This is basically a concept to describe dynamics of innovation process. The author was among the developing members. The Meta-Engineering concept is based on a cycle which consists of four phases: identification and recognition of issue (a. Mining phase); identification of existing and required sciences and technologies to solve the issue (b. Exploring phase); creation of values corresponding to the issue (c. Converging phase); and implementation of these created values in reality (d. Implementation phase). This cycle is named MECI Cycle.

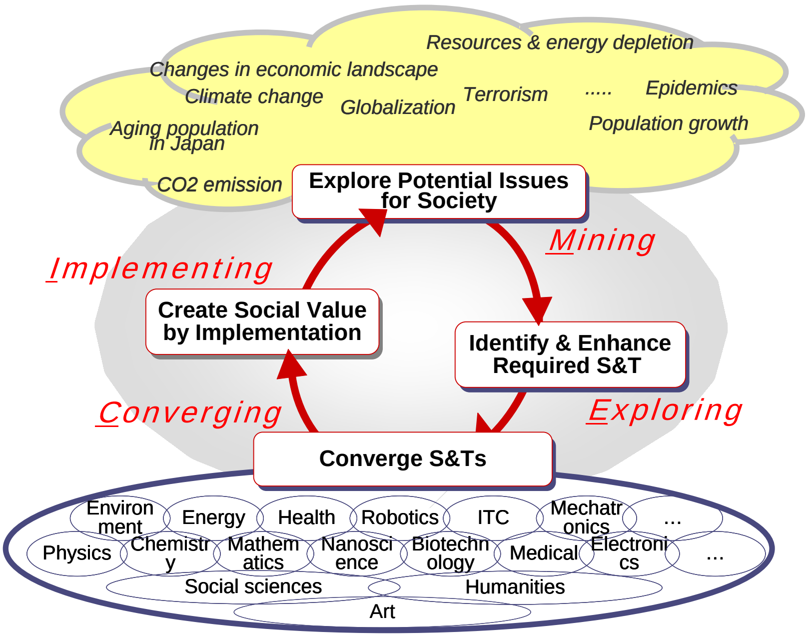

Fig. 9: MECI Cycle

This concept is still under development in a sense of how it is applied in practices (, and in order to verify the applicability to a regional innovation process, a trial to use the MECI Cycle has been conducted, by applying this to a few cases of regional innovation development (Sato, 2012). As a result, it has been proved that the MECI Cycle can be very helpful in describing the whole innovation process in a generic and structured way. Also through this trial two novel points have been proved.

The first one is the explicit description of Mining phase. In considering innovation process, we tend to neglect this phase, by unconsciously assuming the issue is already identified and given. However, it is important to be through this Mining phase because it forces us to undersand reasons and purposes of this innovation process more clearly.

The MECI Cycle can make us realize the importance of Mining phase, by equally putting this phase with other three.

Another novelty of this MECI Cycle resides in the gray-colored oval in the middle of the chart; This gray area implies the innovation process's dependence on surrounding situation, as well as the importance of realizing "jointly and closely working space" among various players in the process. Even a very commonly understood global issue would be tackled through different processes in different circumstances, and in an innovation process there should be close interactions among players. So that it is essential for us to explicitly recognize who are there, who are taking initiatives, what their surrounding situation are, and so on to make the process practical and effective.

4.6 Supporting tools for these frameworks

In order to utilise these five frameworks in the privious sub-sessions, coordinator frequently needs to analyse the situation and judge the most appropriate set of situational settings out of a number of options. As a supporting tools in these circumstances, several lists of those possible settings have been developed and refined through practices, through discussions with UIG practitioners and those who are concerned, and referring to various publications and literatures.

Among those developed lists listed in Table 2, "university's possible reasons for promoting UIG collaboration" and "possible forms" are listed as examples, in Table 3 and Table 4 respectively.

University would promote UIG when it seeks for; √ opportunity, resources and information for research and knowledge transfer √ opportunity, resources and information for education √ understanding of current issues in industry, in society, and in the world √ channel to productization √ incomes from licensing √ employment opportunity for students √ recruitment of students √ researchers and staff mobility √ university's explicit contribution to society etc.

Table 3: Example of Supporting Tool: List of University's Possible Reasons for Promoting UIG

√ Provision of actual topics/issues √ Lectures at university √ Acceptance of internship √ Employing the graduated students √ Re-education of the employee √ Collaborative research √ Research outsourcing √ IP licensing to/from university √ Donation and funding endowment √ Collaboration in curriculum development √ Collaboration to seek for next issues/topics √ Collaboration in social responsibility etc.

Table 4: Example of Supporting Tool: List of Industry's Possible Forms of UIG Collaboration

It can be easily imagined that list of university's possible reasons in Table 3 can be directly used for Five Perspectives (Sub-section C; Figure 6), or Project Description Chart (Sub-section D; Figure 7). However, reasons of promoting UIG may also imply backgrounds issues, targetting purposes, or expecting benefits, whether those are of universities, of industries, or of governments. In this sense, the lists of possible reasons for U, I, and G are very frequently used.

On the other hand, at a glance, it seems that list of possible forms of UIG collaboration, such as Table 4, would be useful only in considering the structure of UIG collaboration, the 5th point in the Five Perspectives. But a form of collaboration implies that there is a provider and receiver of something. Therefore, going through this list would offer more practical image of potential players, of possible benefits they get, and of possible cost and load they need to bear. This means that a coordinator can get more practical ideas about Project Description Chart, especially about the upper part of expected values for other entities, and next steps in collaboration.

These lists are supposed to be revised any time when new or modified items are identified.

5 Application of the frameworks and tools

The frameworks and tools described above have been used, revised, and re-used many times, through the author's practices of UIG collaboration, through classes to educate UIG coordinators, business managers, and governmental officers, and through discussion with practitioners and researchers of UIG collaboration, regional development. and policy planning. As a whole, applicability of these frameworks and tools to the UIG collaboration practices have been more or less verified though not in quantitative or logical sense.

Among the five frameworks, the most well perceived and repetitively used one is Project Description Chart. For these several years, trainees of UIG coordination from various developing countries have worked with this chart in their own UIG program development, and especially those who are concerned with regional or national UIG system development have used this chart as a working chart for themselves, as well as a presentation material in reporting their program development to fellow trainees and their superios at home land.

The second popularly perceived one is the UIG Collaboration Framework. This is rather newly developed one, and has been used in practice and in training only for two years. Even then, it has been already observed that people in discussion with this framework can be more precise in their definition and position in UIG collaboration, thus be clearer and more productive in their discussion. This chart is proved to be useful also in planning UIG promoting strategy or developing related organizations

With the Initial Evaluation Framewok, it is also observed that even those who with little knowledge about the topic could join the evaluating discussion freely. This might be caused by evaluation of "value for the society", which people can imagine rather easily than evaluating specific technologies.

The Five Perspectives proved to be the most difficult one to employ in practices, maybe because the practical situation should be deeply reviewed for this. Typically, most people have hard time to find appropriate expression to each of the five questions (perspectives) at first. However, with the several checking lists as supporting tools and by going through other frameworks back and forth, this framework can be fully and properly described.

The MECI Cycle has, as seen in application to the cases of regional development process, given a coordinator an opportunity to review the whole UIG situation, which have been reviewed through the thinking process of UIG collaboration shown in Table 1, in a structured way. Also, the coordinator can be conscious of innovation process based on that UIG collaboration, and have more society-oriented viewpoint for the next stage.

Though the Thinking Process of UIG coordination in Figure 1 has been proposed here, these are not verified in a strict sense. The similar sequence of those five frameworks has been used in practices and in training, and it worked fine. However, in reality it is found that the thinking works with these frameworks are conducted in a back-and-forth manner several times, so that strict order of those phases may mean less. In this sense, this Thinking Process should be called as a model process.

6 Conclusions and next steps

In this paper, five frameworks and some of associating tools for UIG coordination has been introduced. These have been developed basically through practices, and verified in a practical sense.

These frameworks and tools can neither provide a final solution nor be useful in every cases, because these are just generalized patterns basically induced through real situation and are not fully verified with absolute logics. Depending on differences among topics, cultures and other circumstances, these frameworks and tools should be modified, or should be used in an improvising way.

However, through our breadth of experiences of considering an UIG collaboration system in Japan and in other countries, we have certainly obtained common understanding of a benefit in having some structured frameworks and tools. These could be a good starting point to explore the differences among cases and to have appropriate modification, and provide us a wider view in understanding UIG collaboration and its coordination.

Based on this understanding, it seems important for us first to accumulate practices with these frameworks further, in order to have simple, well generalized, and well structured frameworks for coordination of UIG collaboration toward innovation.

In addition to this framework refinement, coordinator training with these frameworks should be widely implemented to respond to the issue raised in Session 1. Since these frameworks are useful also for business and policy development, and for skills training of researchers and engineers, it seems there should be an opportunity of training business. Considering that training with frameworks naturally requires discussion- and exercise-intensive sessions, and some following sessions to exchange experiences, and these specific features are diligently considered in the training program development. To train UIG coordinators more in quantity and in quality as well, some realistic business schemes are required. For example, training provision as a private company or as an organization like EuKTS Consortium in EU would be a big consideration to build a sustainable training scheme.

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The Scope Of Incubation And Incubators: A Conceptual Analysis

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Abstract

As institutions created for supporting start-ups in solving problems, incubators are nowadays an accepted and important tool for promoting regional economic activity, job creation and especially commercialization of university innovations (Albert et al,. 2002; Allen & McCluskey, 1990; Bergek & Norrman, 2008; Hackett & Dilts, 2004).

As identified by Hackett & Dilts (2004), there is a basic need to increase conceptual clarity about the complexity and the different aspects of incubators and incubation. Therefore, the objective of this paper is to review different variables of business incubation and to integrate them into a comprehensive framework, which shows the scope of incubation and incubators.

The approach is based on the ‘incubator-incubation concept map’ by Hackett & Dilts (2004), which differentiates between three dimensions: The incubator as an organization, its incubation process and its surrounding community. This paper conceptually analyzes each of these dimensions in detail with reference to secondary literature, works out and summarizes their characteristics and enhances the original ‘incubator-incubation concept map’ by adding the found characteristics to the corresponding dimensions. The result is a framework, which comprehensively shows the different aspects of incubation.

In accordance with the 'incubator-incubation concept map (Hackett & Dilts 2004), the new framework divides the individual attributes of incubators into three dimensions: The incubator as an independent agent or organization, the value-generating incubation process and the incubation environment.

The applicability is demonstrated by pointing out the most basic differentiations between the incubators and their incubation processes, the so-called archetypes (university incubators, regional business incubators, company-internal incubators, independent commercial incubators and virtual incubators; von Zedwitz, 2003), in the newly-established framework.

With the help of the framework, incubators can be described and compared more efficiently, which allows for an even deeper understanding of the object of study. Based on this observation, the concrete support potentials associated with some typical kinds of incubators will be outlined in detail.

Furthermore, the results of this study may serve as a foundation for future research, especially for empirical studies. At the same time, such a comprehensive framework may also enable practitioners to examine and compare existing incubators and to systematically design new ones.

Keywords

Incubators, support potentials, archetypes, descriptive framework.

1 Introduction

Entities and organizations, which systematically provide support for companies and those willing to establish their own business, are called incubators. These companies and founders are most frequently facing problems that result from the fact that newly-founded companies are 'new and small' (Soetanto & Jack 2011). Incubators are nowadays a respected means of economic support, especially when it comes to stimulating the economic development of a certain region, the creation of new technology-based companies and increasing the likelihood of success for companies coming from a university background (Bergek & Norrman 2008). However, the current state of research on incubators used by young companies indicates that some wide gaps still exist (Hackett & Dilts 2004; Bhabra-Remedios & Cornelius 2003), thus making further research on this object of study necessary and relevant.

In Germany, Baranowski et al. (2010) and the ADT (German Association of Innovation, Technology and Business Incubation Centers) draw a positive conclusion relating to the work that has been done in the field of support of innovative start-ups: More than 180.000 innovative employment opportunities have been created by more than 20.000 start-ups over the past 25 years. The survival rate of these start-ups amounts to 90%, which is considered incredibly successful (Baranowski et al. 2010). Referring to the university system, Etzkowitz (2002) even predicts that incubators will be fully integrated and an integral part of the 'university of the future'. The objective of university incubators is to enable an organized process of technology transfer and a systematic, not random, support of start-ups at the university. This will eventually lay the foundation for an improved economic and social development in the region (Etzkowitz 2002). Despite being highly relevant, research on incubators has to face wide research gaps: Since every incubator is unique, the overall phenomenon is too multi-faceted and too complex to allow for an easy description. Thus, Hackett and Dilts (2004) even state that there cannot be a uniform and comprehensive definition, which covers the scope and the limits of incubation and incubators. Although recently published works contribute to the topic area by, for instance, having a closer look at certain characteristics (e.g. Bergek & Norrman (2008): Auswahlprozess für neu aufzunehmende Firmen; Soetanto & Jack 2011: Netzwerke von Inkubatoren), a comprehensive framework, which describes all the different facets combined and which could be used as the basis for further comparison of incubators – performance (support potentials in particular) and the results – could not be developed up to today and constitutes a considerable research gap (Bhabra-Remedios & Cornelius 2003).

2 Objectives of the study and methodology

It is the objective of this paper to systematically capture the support potentials of incubators. First of all, the terms 'incubator' and 'incubation' will be looked at in detail. Afterwards, a number of incubator types, better known as archetypes (von Zedwitz 2003), will be introduced. Based on the theoretical foundation provided in the previous sections, the paper will then focus on the three dimensions of the 'incubator-incubation concept map' by Hackett & Dilts (2004): the incubator as an organization, its incubation process and its surrounding community.

After the theoretical foundations have been given, the paper will conceptually analyze the three dimensions of the incubator-incubation concept map by Hackett & Dilts (2004) - the incubator as an organization, its incubation process and its surrounding community - basing this analysis on relevant contributions found in secondary literature. It will then work out and summarize their characteristics and enhance the original 'incubator-incubation concept map' by adding the characteristics to the corresponding dimensions

Afterwards, the deduced framework will be used to analyze the incubator archetypes and to describe their typical attributes and support potentials. Then, the paper will evaluate whether the description of the incubator/incubation phenomenon by means of the framework and the corresponding attributes and support potentials was successful. Finally, a conclusion will be drawn, which will consider the current state of research and indicate the need for further research.

3 Theoretical foundation

The objective of this chapter is to give an overview on the theoretical foundation of incubators.

3.1 Incubators

In order to gain a basic understanding, the process of 'incubation' needs to be set apart from the entity 'incubator', which performs the process. This is important because there are also non-incubators, such as the Business Angels or Venture Capital organizations, which perform the same or similar tasks and offer comparable support to young companies (Hacket & Dilts 2008). Moreover, Phan et al. (2005) also point out that the term 'incubator' is not only used for bounded and definable agents, but also for amorphous regions, in which founders are supported. In this paper, however, the term will be used in accordance with the meaning provided by Bergek and Norrman (2008), which is that of the incubator as a distinguishable and independent agent. These observations lead to a basic concept, in which the incubator – as an independent agent – and the incubation processes aim at supporting companies in a way that they can severe their ties to the incubator and work as independent organizations after the incubation period is over (Hackett & Dilts 2004).

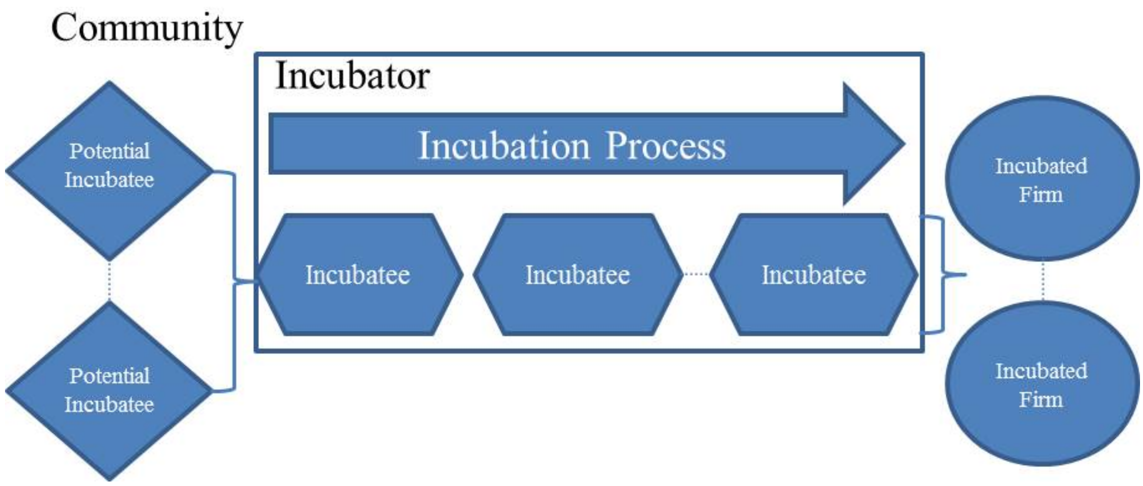

Figure 1: Incubator-incubation concept map (Hackett & Dilts 2004)

Companies, which are part of an incubator, are called ’incubatees’, ’portfolio-companies’, ’client-companies’ or ’tenant-companies’ (Hackett & Dilts 2004).

There is consensus that the modern process of incubation consists of four important components (Edquist 2011; Soetanto & Jack 2011; Patton et al. 2009; Bergek & Norrman 2008; Bøllingtoft & Ulhøi 2005; Chan & Lau 2005; Aernoudt 2004; Hackett & Dilts 2004; Peters et al. 2004; von Zedwitz 2003; Allen & McCluskey 1990):

(1) office space

(2) support when it comes to avoiding additional costs and making use of synergy effects

(3) business support in the form of coaching, mentoring or consulting services

(4) access to the network of the incubator

As part of an incubator, incubatees are able to use the existing infrastructure of the incubator. Besides, the incubator may help them shorten their learning periods and find solutions to problems faster with both the support of the incubator and the network (Hisrich & Smilor 1988). If the incubator has a positive reputation and guarantees a certain standard of quality for its portfolio-companies, the portfolio-companies will also benefit (Hisrich & Smilor 1988).

Another important characteristic of an incubator is the relation to the surrounding community, in which it is embedded (Edquist 2011; Albert et al. 2002; Hackett & Dilts 2004), since this is what determines, for instance, the competition for founding teams and resources. Regional conditions exert a direct influence, for instance through the availability of public funds or public support in general. Furthermore, there is also a number of publicly funded incubators, which are operated with the aim of permanently strengthening the regional economy by creating new jobs and employment opportunities (Allen & MacCluskey 1990; von Zedwitz 2003). From a regional perspective, the start-up phase of the incubator itself begins with the founding proposition and is considered successful as soon as the incubator has developed into the center of all founding activities in the region (Allen 1988).

3.2 The archetypes of incubators by Zedwitz (2003)

Basing their study on the Allen/McCluskey continuum (Allen & McCluskey 1990), Fahrenberg et al. (2009) identify the following incubator typology: ’regional business incubators’ (e.g. technology centers), 'university incubators' (e.g. at universities), company-internal incubators (e.g. in the area of 'Research & Development') and independent commercial incubators. Von Zedwitz (2003) also names these three types of incubators as being typical - and thus 'archetypes' - and defines them by their objectives as well as their focus on an entrepreneurial field of activity. In von Zedwitz's (2003) view, a particular industry (e.g. biotechnology), a geographic region or a certain target group (e.g. researchers) are to be considered possible fields of activity for the incubator (cf. Figure 2). According to Zedwitz (2003), there is even one more archetype that has so far gone unmentioned: the 'virtual incubators'. The particularity of these incubators is that office space is not part of their offers and services and may, for instance, be replaced by a jointly used internet platform (von Zedwitz 2003).

Overall, it has to be noticed that all archetypes exist both in their pure form and as hybrids (Fahrenberg et al. 2009; von Zedwitz 2003). Regionally funded incubators have - in accordance with their mission statement - a local focus and are used as tools for promoting the regional structure and for creating new employment opportunities (Fahrenberg et al. 2009). University and research-affiliated incubators typically prioritize researchers as their target group (von Zedwitz 2003). Corporate incubators are substantially influenced by their target group, the employees of a certain company (Albert et al. 2002), and their closeness to the parent company (von Zedwitz 2003). According to Zedwitz (2003), private incubators that focus on return are characterized by their clear orientation towards on technologies, industries and a particular, possibly geographic, market. A summary of the incubator archetypes, their fields of activity and their profit orientation can be found in figure 2.

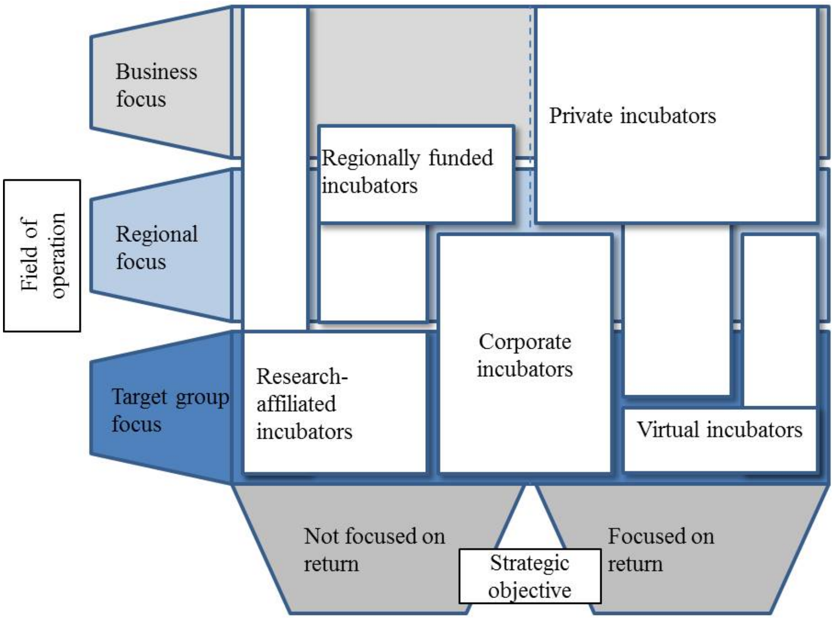

Figure 2: Fields of activity and strategic mission of different incubator archetypes (von Zedwitz 2003; Fahrenberg et al. 2009)

4 The reconceptualization of the 'Incubator-Incubation Concept Map' by Hackett & Dilts (2004)

The objective of this chapter is to provide a literature review of the individual elements belonging to the 'incubator-incubation concept map' by Hackett & Dilts (2004), to work out and summarize their characteristics and to enhance the original 'incubator-incubation concept map' by adding the found characteristics to the corresponding dimensions.

4.1 Literature review: The incubator as an organization

The goals of incubators are defined by their promoter, which makes the promoter an important component in the process of characterizing the incubator.

(e.g. Mian 1994; Fahrenberg et al. 2009). Publicly funded incubators, such as regional or academic incubators, tend to be non-profit and pursue the goal of adding value to the respective society, while profit-oriented incubators tend to be run either by individuals or companies (Albert et al. 2002; von Zedwitz 2003; Fahrenberg et al. 2009).

The business model is another characteristic of incubators. The most common revenue streams are rental fees, service fees, service contracts, private sponsorship, public subsidies and growing equity value (Miller & Bound 2011).

The team is another critical component of each incubator (Patton et al. 2009; Hacket & Dilts 2004; Christiansen 2009). Its knowledge and expertise determine the quality of its services and value-add, while its quantity in comparison to the number of incumbents hints at the intensity of support and supervision.

Usually build to support start-ups or companies in early stages (Bergek & Normann 2008; Hackett & Dilts 2004), incubators can focus on adding value in later stages, too. Therefore, the targeted company stage should be taken into consideration when describing an incubator.

Incubators can be examined by looking at their degree of specialization: When they do not focus on a certain branch, incubators tend to render rather general services (iDisc 2012). Very specialized incubators may be able to add more in-depth value, but are relevant to a fewer number of start-ups.

All incubators differ with regard to their offering and charges.

4.2 Literature review: The incubation process

The first part of the incubation process is to admit the right incumbents to the incubation. Incubators can be classified by their valued criteria (Adkins 2001) and their selection strategy (Bergek & Norman 2008).

The intensity of the incubation process is another important aspect, ranging from a reactive ’laissez faire‘-approach to a very proactive ’strong intervention‘-approach (Bergek & Norman 2008).

The first area of support for the incumbents is the provision of shared office space, infrastructure and infrastructural services (Hackett & Dilts 2004) in order to foster knowledge transfer between the incumbents and reduce additional costs.

To shorten the learning period and to be able to solve problems faster, incubators offer various business advice, consultancy and mentoring programs to their incumbents (Hisrich 1988).

Incubators often support their incumbents on a financial level, either by investing their own money or by supporting them with finding investors (Allen & McCluskey 1990).

Another important way of providing value to their incumbents is granting them access to the internal network (e.g. other incumbents) and the external network (e.g. partners) (Soetanto & Jack 2011).

4.3 Literature review: The community of the incubator

While the surrounding community is unique to each incubator, the most important aspects can be generalized.

Very important for incubators are the existing sources of entrepreneurial talent and resources for entrepreneurs, e.g. universities, as well as regional special knowledge (Tamasy 2007, Etzkowitz 2002). Finally, the degree of competition between existing incubators is a very important characteristic of a region (Albert et al. 2002).

The following figure displays the new 'Incubator-Incubation Concept Map', including all the sub-dimensions that have been identified in the preceding literature reviews.

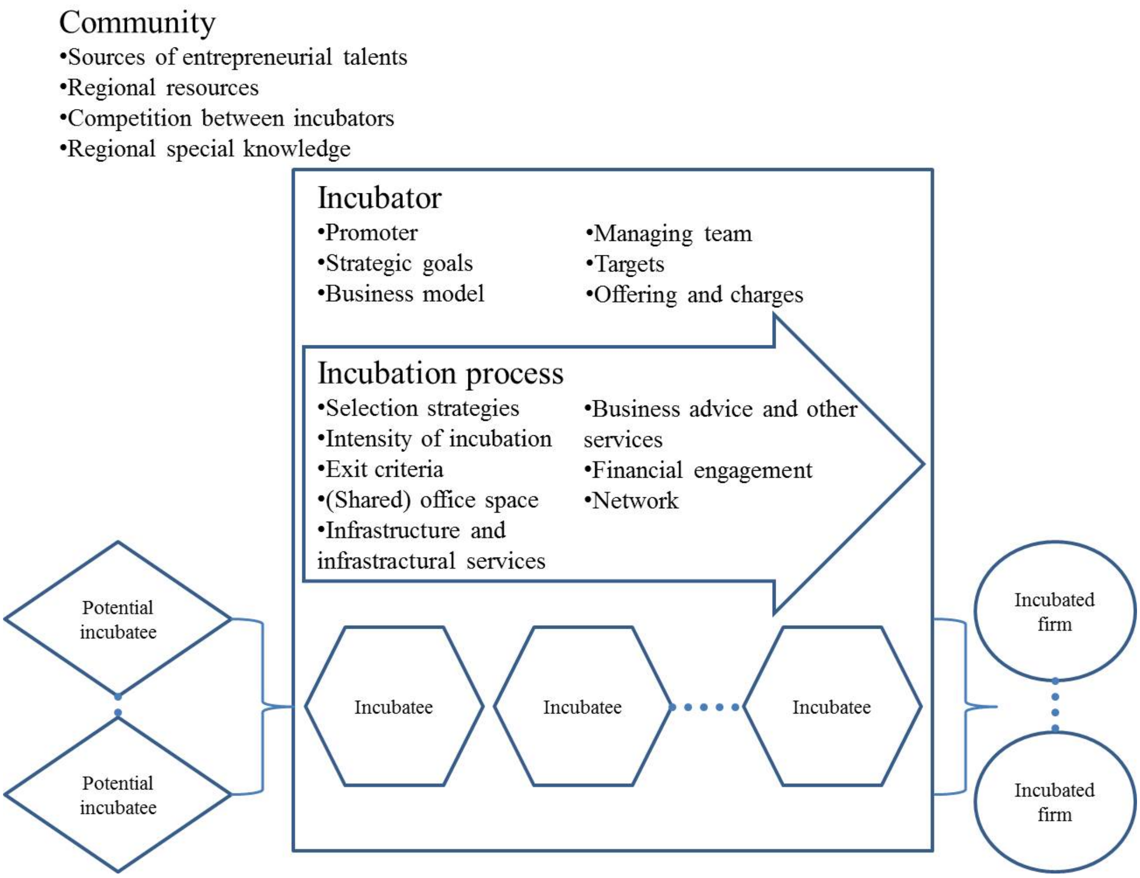

Figure 3: The enhanced incubator-incubation concept map

5 Applying the new concept map to each archetype

Following the typology of von Zedwitz (2003), this chapter will outline the organizational design and the design of the incubation process of a regional business incubator, a university incubator, company-internal incubators and an independent commercial incubator. The organizational design is characterized by the promoter, the strategic goals, the business model, the managing team, the targets (entrepreneurs and branches) and the offering and charges; and the design of the incubation process is characterized by the selection strategy (founder/idea and 'survival of the fittest' vs. 'picking the Winners'), the intensity of incubation, exit criteria, office space and infrastructural support services, business advice and other services, financing, networks and networking (internally and externally).

This chapter aims at showing the applicability of the newly-created 'Incubator-Incubation Concept Map' by using it to describe each archetype. Only the dimension 'Community' is highly individual and therefore not generalizable in this regard.

The following table displays the typical organizational design of regional business incubators, based on secondary literature (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Organizational design	Regional business incubator
Promoter	• Regional or local administration, business development • Chamber of commerce and industry • Sponsors • Foundations or not-for-profit companies/ societies
Strategic Goals	Profit-oriented: No
	• Job creation • Economic development • Structural development • Support of high-tech companies • Building Networks • Image improvement
Business model	Primary source of income • Rental income • Income from incubator services • Public income/subsidies
Managing team	Top management • Representative of the public promoter
	Team • Rather few • Background based on provided services, rather basic level of support (e.g. basic advisory services)
Targets (Entrepreneurs and branches)	• Broad target group • Small commercial craft or service companies • In some cases high-tech companies
Offering and charges	• Basic, rather standardized services (e.g. advisory services) • Standardized charges (if existing)

Table 1: Organizational design of a regional business incubator

The next table describes the typical design of the incubation process of regional business incubators (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Incubation process	Regional business incubator
Selection Strategy (Founder/Idea and 'Survival of the fittest' vs. 'Picking the Winners')	• Access to services granted to the founder • 'Survival of the fittest'
Intensity of incubation	• Rather laissez-faire
Exit criteria	• Usually end of defined incubation period or early success
Office space and infrastructural support services	• Office space • Facility management • Secretary services etc.
Business advice and other services	• Generic advisory services • Administrative assistance • Networking
Financing	• Usually no own investment • Advice about financing possibilities
Networks and networking (internally and externally)	• Internally: Portfolio companies are loosely connected due to heterogeneity of the portfolio • Externally: Stronger connection to public offices

Table 2: Incubation process of a regional business incubator

The typical organizational design of university incubators, based on earlier findings (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009), will be given in the following table.

Organizational design	University incubator
Promoter	• Universities and research institutes • Regional institutions • Foundations and not-for-profit companies/ societies • Corporations • Sponsors
Strategic Goals	Profit-oriented: No
	• Support of knowledge-intensive ventures with academic background • Commercialization of university research • Technology transfer • Development of entrepreneurial spirit • New sources of finance • Image improvement
Business model	Primary sources of income • Public income/subsidies • Sponsoring • Equity income
Managing team	Top management • Representative of the affilitated research institute
	Team • Rather few • Strong connections to the research institute or university
Targets (Entrepreneurs and branches)	• Specific target group • Commercialization of scientific research • University graduates or member of the research faculty

Offering and charges	• Rather standardized offering • Standardized charges (if existing)

Table 3: Organizational design of a universiy incubator

Table 4 gives an overview on the typical design of the incubation process of university incubators (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Incubation process	**University incubator**
Selection Strategy (Founder/Idea and 'Survival of the fittest' vs. 'Picking the Winners')	• Idea usually has to be in line with research • Founder has to have connection to the research institute • Rather 'Picking the Winners'
Intensity of incubation	• Rather intensive
Exit criteria	• Usually end of defined incubation period or early success
Office space and infrastructural support services	• Office space • Cost-intensive, technical infrastructure (e.g. laboratories) • Maintenance services
Business advice and other services	• Mentoring • Basic Management advice • Concept Testing • Consulting & business support • Networking • Intellectual property advice
Financing	• Seed capital • Basic financing advice • Access to business angels and venture capitalists
Networks and networking (internally and externally)	• Internally: strong connection between portfolio companies and research institute • Externally: Access to the academic/research network

Table 4: Incubation process of a universiy incubator

The following table depicts the typical organizational design of independent commercial incubators (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Organizational design	**Independent commercial incubator**
Promoter	• Venture capital companies • Consulting firms • management companies in the property business
Strategic Goals	Profit-oriented: Yes
	• Profits by selling stocks of portfolio companies • Best possible portfolio selection • Investing in technology- and growth- oriented ventures • Creating synergies between portfolio companies

Business model	Primary sources of income • Rental income • Private sponsoring • Equity income
Managing team	Top management • Often experienced entrepreneurs or practitioners with broad experience (e.g. consultants)
	Team • Combination to support ventures as effectively as possible • Experts for specific areas of interest
Targets (Entrepreneurs and branches)	• Specific target group • Start-ups or entrepreneurs with promising return on investment
Offering and charges	• Rather individualized offering (determined by how to leverage the success of the company) • Rather individualized charges (based on an agreed on-company valuation)

Table 5: Organizational design of an independent commercial incubator

The incubation of independent commercial incubators will be outlined in the following table (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Incubation process	**Independent commercial incubator**
Selection Strategy (Founder/Idea and ’Survival of the fittest’ vs. ’Picking the Winners’)	• Selection based on perceived outcome (mostly on the combination of the founder being capable of executing an attractive business case) • ’Picking the Winners’
Intensity of incubation	• Very intensive
Exit criteria	• Portfolio company matures and becomes independent • If the probability of success diminishes, the project is dropped
Office space and infrastructural support services	• (Shared) office space • Facility and office services to save overhead
Business advice and other services	• Management and strategy advice • Personal networks • Legal services, public relations, recruiting etc. …
Financing	• Supply of one or several types of financing and search of complimentary services
Networks and networking (internally and externally)	• Internally: Strong connection between portfolio companies (creation of synergetic effects) and with incubator personnel • Externally: Network support, esp. for business development and financing issues

Table 6: Incubation process of an independent commercial incubator

The following table displays the typical organizational design of company-internal incubators. These findings, again, are based on secondary literature (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Organizational design	Company-internal incubator
Promoter	• Parent company
Strategic Goals	Profit-oriented: Yes
	• Development of entrepreneurial spirit and skills among employees • Foster innovation • Support R&D • Monitoring new markets and trends
Business model	Primary sources of income • Company resources
Managing team	Top management • Employees of the promoting company in executive positions
	(extended) Team • Various connections to people from the parent company (e.g. marketing, legal)
Targets (Entrepreneurs and branches)	• Internal and external projects, generally related to the activity of the company
Offering and charges	• Not relevant due to affiliation with parent company

Table 7: Organizational design of a company-internal incubator

The findings concerning the typical design of the incubation process of company-internal incubators lead to the following table (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Incubation process	Company-internal incubator
Selection Strategy (Founder/Idea and 'Survival of the fittest' vs. 'Picking the Winners')	• Selection based on the idea • 'Picking the Winners'
Intensity of incubation	• Intensive
Exit criteria	• Depending on the assessment of the parent company
Office space and infrastructural support services	• Office space • Test infrastructure for prototypes
Business advice and other services	• Prototype and market testing • Access to multiple competencies • Access to commercial markets • Networking
Financing	• Financial resources (provided by parent company)
Networks and networking (internally and externally)	• Access to network of the parent company

Table 8: Incubation process of a company-internal incubator

The subsequent table explains the typical organizational design of virtual incubators, The facts are again derived from literature (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Organizational design	Virtual Incubator
Promoter	• Universities and research institutes • Public sponsors • Private service providers/ companies
Strategic Goals	Profit-oriented: Depending on ownership
	• Providing a platform and network for members • Aggregation of information • Providing reach to its members
Business model	Primary sources of income • Membership fees • Service fees • Grants • Public support • Corporate Sponsorship
Managing team	Top-management • Depending on ownership
	Team • Usually focus on developing the platform instead of giving one-to-one support to its members
Targets (Entrepreneurs and branches)	• Potentially every startup or entrepreneur who benefits from the platform
Offering and charges	• Same offering for each member • Same charges for all members

Table 9: Organizational design of a virtual incubator

The typical design of the incubation process of virtual incubators is described in the following table (esp. Mian 1994; Hackett & Dilts 2004; Albert et al. 2002; Fahrenberg et al. 2009).

Incubation process	Virtual incubator
Selection Strategy (Founder/Idea and ’Survival of the fittest’ vs. ’Picking the Winners’)	• Typically no barriers for admission to the platform
Intensity of incubation	• Laissez-faire
Exit criteria	• Usually if membership fees are not paid
Office space and infrastructural support services	• None
Business advice and other services	• Access to the network of the platform • Online matchmaking • Aggregation and access to information
Financing	• Access to business angels and venture capitalists on the platform • Information on investment issues
Networks and networking (internally and externally)	• Network of all platform members and possible access to their contacts

Table 10: Incubation process of a virtual incubator

6 Summary of results

Secondary literature was used as a means to deduce a comprehensive framework concerning the relevant attributes and support potentials of incubators, which, in turn, helped pointing out the general potentials of incubators and the more specific potentials of the archetypes. It particularly is the separation into actors and incubation process, which facilitates a consistent observation of the numerous influences and aspects. The framework makes a description of the incubators and correspondingly the found dimensions possible, although the description does not allow for too much detail. There is further need for research on the attributes of incubators and incubation processes, since each attribute assigned to incubators and incubation processes can be looked at in more detail. It seems particularly challenging to identify possible indicators of quality for the respective attributes: How, for instance, can the added values of the management team be expressed through a commensurable number? To what extent can one draw parallels between the added value in a certain region and the added value in other regions? If comparable indicators of quality to express the different support potentials can indeed be found, the framework may be complemented and then be used as an instrument of evaluation.

A first practical application was shown through the process of explaining the typical incubators, the archetypes, with the help of this newly-constructed framework. This leads to a basic understanding of the different archetypes and their corresponding support potentials, as well as to a description that is more detailed than the ones found in previous works and which results from the merging of many different sources (e.g., Fahrenberg et al. 2009; Hackett/Dilts 2004; von Zedwitz 2003; Albert et al. 2002). This paper contributes to the current state of research by making it possible to better observe and describe this interesting research area and the different archetypes with the help of this framework.

7 Limitations and further research needs

It can be noted that a body of source material does exist and that the topic has also been dealt with in some major journals since 1984 (Hackett & Dilts 2004). However, the number and frequency of contributions is rather low. Furthermore, most of the statements and results are not backed by current empirical data or data that has a sufficient sample size. Although the more practically oriented works of various incubator organizations (e.g. ADT (D); NBIA (USA); NESTA (UK)) provide current results and numerical data, they cannot readily be considered scientific sources and need to be handled with care.

Overall, there is a great need for further empirical research. For instance, it is the composition of the portfolio that constitutes one of the most influential factors for the success of the incubators from the incumbents' viewpoint (Bergek & Norrman 2008; Peters et al. 2004). In spite of this finding, there are no comprehensive works that describe the current composition of the portfolios of (certain archetypical) incubators or the selection strategies used for the composition of their portfolios. Another research gap can be identified: For what reasons and in what way does business between incubators and start-ups come into existence; how satisfied are they with the results; and can 'Best Practices' be identified? Consequently, it would be highly interesting for incubators to find out in which way portfolio companies prefer to pay their charges (e.g. a single charge or monthly charges), so that incubators can optimize their offering.

Concerning admission criteria and strategies, it could also be empirically validated, whether the separation between idea and founding team is really as strict as Bergek & Norrman (2008) suggest or whether this combination, in fact, has to be harmonious. Also, it could be validated which criteria are typically applied.

For future works dealing with further enhancing the framework with the aim of turning it into an instrument of evaluation, indicators of quality or quantifiers could be attributed to the respective characteristics, by means of which it may be possible to capture the effects of the support potentials.

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A New Approach For The Valorization Of University Research

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Abstract

Today, Companies are struggled in building and defending long-term competitive advantages, in order to acquire new knowledge because of incorporate it into products, processes, and services. In this scenario, the system of University research plays a more strategic role than in the past, and becomes a key factor in terms of economic growth. Universities, while are spreading knowledge through highly trained human resources, have a potentially strategic wealth of scientific and technological knowledge, if addressed in exploiting industrial and production applications. Objective of this work is to propose a criterion to "weigh" the real value of an invention, providing valuable information in terms of importance, investments, revenues, utility, compared to its industrial market. The proposed methodology allows to obtain a weighed value, related to a specific innovation, which should be an indication in order to develop it, trying to maximise profits. Initially a sample of twenty products scouted by University research were identified, and several parameters related to the costs, technology, time of realization, and other aspects concerning the product, were associated to each one. A second phase of the research, was focused in analysing the reference markets of each product. In a particular way dimension, trend, position, and utilization of the product, inside the target application were investigated together with other parameters as well. By using a particular break even point (Numerical BEP) diagram, calculated taking into account specific coefficients, a single numerical value, ranging from 1 to 5, is the obtained output as final result. The proposed experimental method may have a lot of advantages; first of all it can estimate an application without the influence of its inventor; it is a general method, every kind of product can be analysed. Moreover the final formula can be modified by introducing different variables where necessary, and it gives as results an unambiguous value that is understood by everyone and can't be exploited. The obtained results indicate only three applications potentially interesting, and two of them are already submitted to the clients. It is interesting to notice how the method can consider all the aspects even if the application results effective, not very expansive, technologically convenient and suitable, but the reference market doesn't give enough guarantee to sustain the entire project. The development of new technologies, depends not only by the ability to innovate in a strictly scientific-technological way, but also by the capability to interact with a specific target market.

Keywords

Valorisation, pre competitive research, innovation.

1 Introduction

Under the pressure of the socio-economic and legal-institutional changing, happened in the last ten years, universities have undergone significant internal transformation that has helped to shape new strategies in the university and its relationship with the territory and with the various stakeholders. Thus Academic Centres become the new frameworks in the institutional system of relations, actors of development and promotion of the territory. This kind of process was widely supported and encouraged by policies, already at the end of the '80s, by focusing the attention on the local dimension, while a development, from the second half of the 90s, was prosecuted to revitalize national processes of research and industrial innovation through specific interventions and economic supports. In absence of specific standards information and guidelines, a remarkable variety of solutions have been exploited based on experimental models, or tools, involving national, regional, or local levels, hence the proliferation of science parks, incubators and university spin-offs. In Italy, in particular, this development took place in a disorganized and poorly way, helping to create confusion in anyone involved in technology transfer or regional development; because of the proliferation of too many places/government actors managing the organization of these policy areas. The positive element that can be evidenced in this state of affairs lies in a multitude of successful experiences, deserving to be investigated, as best practices examples, in order to assess possible technology transfer models, and to set up the system of innovation paths by starting from the bottom. The exploitation of research contains, as its fundamental components, although not exclusive, protection and use of the IP, and creation of spin-off companies, which are closely interlinked. An element, that perhaps many researchers-entrepreneurs neglect, is a realistic assessment of the temporal distance between time of invention and time when the market will be able to absorb it, as well as implications of assessment. For example, the business models, related to life sciences, are often oriented in development research and then in licensing it, whereas other areas are orientated toward the sale of consulting services (for example in ICT and environmental), or at the end the sale of "finished" products (in ex. in electronics and biomedical equipment). In many cases, the spin-off companies can profit of many benefits, this is the case of all those services which need equipments and machines particularly expensive, directly usable in the laboratories of the EPR source (against a specific contract). In other areas, the activity of spin-offs needs high investments, both in research and in production, thus activities of planning and involvement of external partners are strongly required. Currently we are living a sort of fifth phase in the national context, especially in terms of number of jobs created, science and technology sectors concerned, but also in terms of geographical spread throughout the country. This phenomenon has many elements of considerable interest in terms of:

- Optimization of results of public research;
- Closing the gap between public research and industrial innovation;
- Transfer of technology solutions to small and medium-sized high-tech companies;
- Creation of new skilled jobs for graduates;

› Acceleration of economic development on a local and regional basis, especially through aggregation, even in incubators, high-tech firms.

2 Methods

The production process is possible by a number of factors, it "consumes" the value of the used resources and services in order to obtain a "superior” utility. These factors are elements of cost. The production (output) is a cost object (or determinant). Other possible cost objects are: processes, work centres and activities. The cost, related to a single factor used to obtain an output Qp, is the economic value which must be at least obtained by selling the product Qp. It is necessary to determine the trend of costs in relationship with the changes of relevant parameters connected to their generation. In order to define a methodology of analysis it is important to identify: the cost which is object of analysis, the factor related to the cost (determinant of cost - cost driver), and its range of variation, the time period to which refer the analysis. The object of analysis may be a basic cost (in ex.: A raw material) or a grouping of costs (cost of a department). The determinant of cost, or cost driver, influences directly the cost: a variation of the first implies a variation of the second, the choice depends on the analysis. The period of time of observation must finally be clearly defined: in a lengthy period the costs will be subjected to a wide variability. Otherwise a too short period doesn’t allow the costs to be accurately foreseen (in ex.: Labour cost on a weekly or yearly). In reference to a generic determinant of cost, and within the area of relevance, the costs can be distinguished in:

Fixed Costs: they do not depend on volumes achieved (within limits) and include: scheduled maintenance costs, fixed cost of direct labour, factory overhead, depreciation of the plant. They can be calculated as:

$C = FC = const.$

Variable Costs: They grow proportionally to the production and may be: cost of raw materials, cost of direct material consumption, cost of direct labour energy.

Mixed Costs: They increase, within an area of importance, at intervals of variation of the cost driver. They can be formed by a fixed part and a variable cost percentage, in ex. $C = CF + cv \cdot Q$, where CF is the fixed cost, while $cv \cdot Q$ is the variable one.

During the production process in order to evaluate the overall plan costs a stratification of elementary costs need to be carried on which gradually will allow, by adding each elementary cost, to estimate the final cost of the product. Moreover the revenues arising from a production, can be decomposed by progressively subtracting different kind of costs, obtaining in this way the “margins”. In particular, by subtracting from revenues the costs of materials and services purchased and used in production, it is possible to calculate the added value. Regardless of the calculation method, the production costs have two separate but complementary meanings.

It is defined cost of production, C (P), of a production P, the sum of the values of the factors N, C (Fn, P) which are considered "productively consumed" in order to obtain P, equation 1.

[1] $$C(P) = \sum_{n=1}^{N} C(F_n, P)$$

The production P is also called object of cost.

The factors used to obtain Fn are the elements of cost.

The values of the elements cost, C (Fn, P) are defined primary or basic costs.

A start up business will utilize a Break Even Analysis to calculate whether or not it would be financially viable to produce and sell a new product or pursue a new venture. This analysis is a common tool used in a solid business plan. The formulas for the break even analysis are relatively simple, but it can be difficult coming up with the projected sales, selecting the right sale price, and calculating the fixed and variable costs. The break-even point (BEP for short) is a value that indicates the amount of product sales, expressed in volume of production and sales, needed to cover the costs previously incurred to close a production period without profits or losses. The formula used to calculate a break even point (BEP) is based on the linear Cost-Volume-Profit (CVP) Model which is a practical tool for simplified calculations and short-term projections. All the different types of break-even analyses are based on the following basic equation 2:

[2]
$$\begin{aligned} &\text{Total Costs} = \text{Total Revenue} \\ &TC = TR \\ &TFC + TVC = P \times X \\ &TFC + (V \times X) = P \times X \end{aligned}$$

The variables and definitions used in the break-even equation are listed below.

P = Selling Price per unit

V = Variable Cost per unit.

X = Number of Units Produced and Sold

*TR = Total Revenue = P * X*

TC = Total Costs = TFC + TVC

TFC = Total Fixed Costs

*TVC = Total Variable Costs = V * X*

P-V = Contribution Margin per unit (CM)

CMR = Contribution Margin Ratio = (P - V) / P

The Payback Period is the time it will take to break even on your investment. In break-even analyses in which are are solving for the break-even price or number of sales, the payback period is defined ahead of time. Depending on rate of change in your market, this may be a few months or a few years. Or, if you are just starting a business, your bank may want to see evidence that you will start making a profit after 18 months, or some other period. The break even analysis is a method that allows us to know how to change output levels to reach the break-even point between costs and revenues. But this is not a popular method because it takes into account the constant prices thus it is valid only in the short term, it doesn't take account of seasonality, it isn't too easily handling by the companies, and finally it doesn't consider the stocks.

By overcoming these limitations, the method can, however, give useful indications when accompanied by other financial methodologies, it results very useful in investments with a high risk of obsolescence or when an immediate estimation of the re-entry period is required. Taking into account certain factors that influence the production such as: trend of market, production efficiency, and innovation percentage of the product, are defined the coefficients C_1, C_2, and C_3. The coefficient C_1 (Market Index), fig. 1, is calculated by representing the trend of reference market expressed in months on the abscissa axis, while in the ordinate axis is reported the coefficient C_1 as well, variable between the values 0 and 1. The numerical value of C_1 is obtained by intersecting with the ordinate axis, the regression line of the curve obtained by assigning a value of 1, in case of positive trend of market, within the considered period time, or 0 in the opposite case. The coefficient C_2 (Production Index), fig. 2, variable between 0 and 1, is constituted by a family of curves, represented in logarithmic scale, obtained in relationship with the number of produced pieces and the annual production cost. Finally, the coefficient C_3 (Innovation Index), also variable between 0 and 1, fig. 3, is represented by a family of curves calculated in function of the "Economic Efficacy Ratio" on the ordinate axis, expressed as the ratio between the production cost of a single piece and the global production cost of the final product ready to be sold, and the "Time Efficiency Ratio" on the abscissa axis, expressed as the ratio between the production time of a single piece and the global production time of the final product ready to be sold. Based on the above considerations, the above equation 2 becomes, formula 3:

[3] $$X = \frac{TFC}{C_1 \cdot C_2 \cdot C_3 \cdot CM}$$

Taking into account the above mentioned coefficients, and the equations 1, 2, 3,; it is possible to draw the Numerical BEP diagram, in fig. 4, which shows clearly how to extrapolate the numerical value associable to the considered Numerical BEP.

As it can be seen in fig. 4, as soon as the break-even point is reached, in spite of the maximum units sold, the better will result the potential beneficial furnished by the proposed innovation. Decreasing values from 5 to 1 classify the favourability innovation considered.

A sample of twenty innovative ideas scouted inside University research products were identified, and several parameters related to the costs, technology, time of realization, and other aspects concerning the product, were associated to each one, in order to evaluate possible staring up initiatives.

A second phase of the research, was focused in analysing the reference markets of each product. In a particular way dimension, trend, position, and utilization of the product, inside the target application were investigated together with other parameters as well.

3 Results and discussion

The results of technological scouting conducted at the University of Messina are shown in table 1. In particular, were identified four interesting ideas aging in electronics industry, four in the Nanotech and new materials, two in the energy sector and the environment, four in the industrial automation and finally six aging in the biomedical field. For each of the examined purposes an information module was asked to be compiled by the proponent of the innovative technology. The module was conceived in order to furnish data about several parameters related to the costs, technology, time of realization, and other aspects concerning the product. It must be considered that these information were furnished by academic staff, which can't be deeply involved in the complexity of each productive market. Moreover it was explicitly asked to the researchers, to taking into account the concrete possibility to became an university spin off, thus many facilities as instrumentations, rooms, web connections etc., were neglected in the effective costs.

A second phase of the research, was focused in analysing the reference markets of each product, in figgs. 5, 6, 7, 8 are reported same collected data about the most important reference market sectors. Finally a simple report was produced for each innovative propose and the results are reported in table 2. The table reports the acronyms of proposals, their own numerical BEP, the calculated values for C_1, C_2, and C_3, annual costs and the number of products furnished. Last column was used to indicate particular notes relative to some proposals.

Two of the twenty selected proposals were judged not really innovative, already present in market and any case not competitive. In spite of this four of them were judged as not yet ready for industrial application because of their not complete development in performances, not enough prototyped, even not clearly indicated their potential application use. The remaining fourteen ideas have been analysed with the numerical BEP method. Only three of them have reached a Numerical BEP value ranging between 3 and 4.

The causes of this kind of result, which is not negligible, must be searched in many factors. First of all the basic research rarely can answer to the market demand, this happens only for great innovations, more generally, market demand is very specific and needs dedicated solutions. Another determinant factor is concerned to the economic sources, less and less available, sometime obtained by national or international research projects which otherwise need time, people, and organization to be exploited. A not small problem is connected to the researcher’s mentality, often driven by the academic motivations and difficult to be changed in a business address. Moreover, the not real objectivity, by the researcher, can deeply influence a fruitful development of a potentially interesting idea.

Two of the three proposals which has reached a positive numerical BEP, are today spin off of the University of Messina, and have been contacted by external costumers in order to furnish an annual commission. In conclusion this method doesn’t pretend to replace any kind of study, methodology, or technique traditionally used to evaluate the university research products but, as already evidenced, is more or less fast, easy to use and especially clear, it gives a value that can’t be misunderstood.

By the other hand, it can be more developed and improved, but also deeply influenced by the furnished information. Independently by the methodology that can be used, in order to evaluate the university research products, a more simple, but at the same time detailed, data base system information should be desirable. It is evident that in the immediate future the birth and the life prediction of new industrial subjects will became an important aspect of the global economy, thus more advanced economic instruments will be necessary.

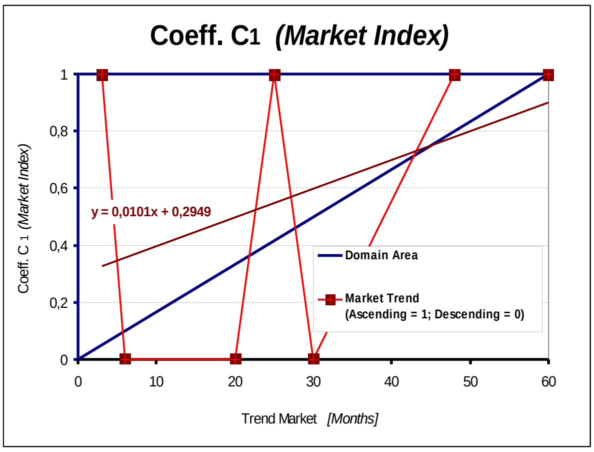

Fig. 1 – Market Index Coeff. C1 calculated in ex. for electrical devices at 60 months

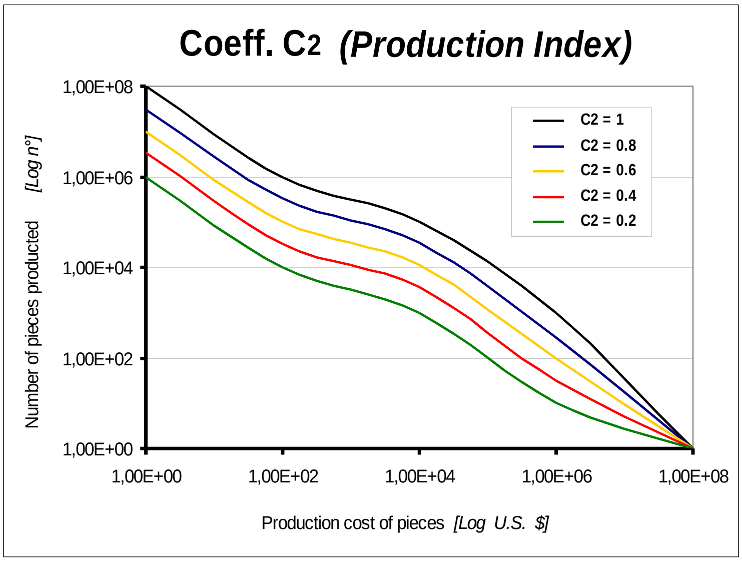

Fig. 2 – Production Index Coeff. C_2 calculated as N° of produced pieces vs. Production Cost of pieces

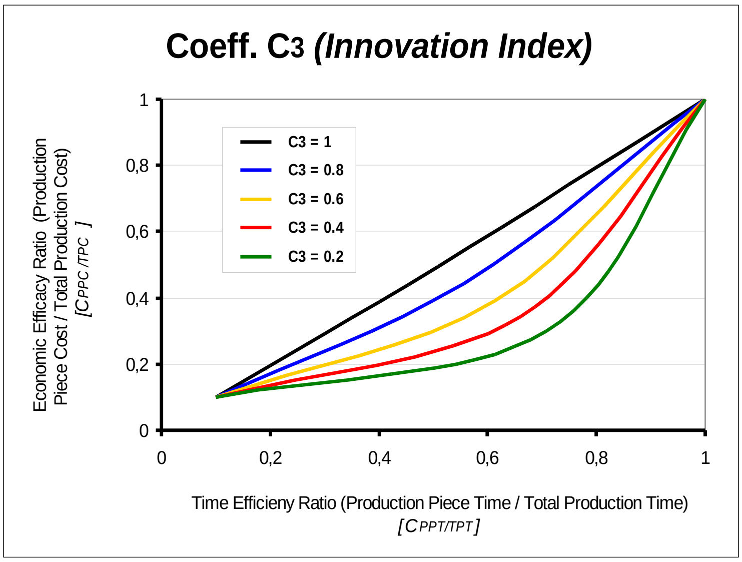

Fig. 3 – Innovation Index Coeff. C3 calculated by Economic Efficacy Ratio vs. Time Efficiency Ratio

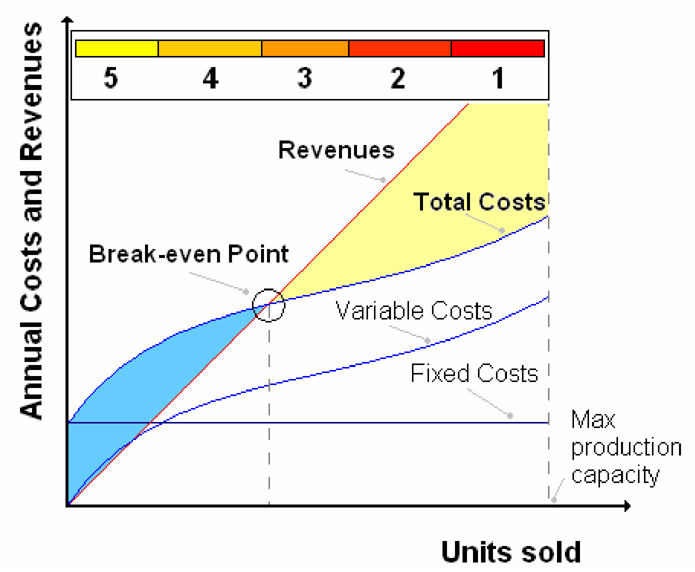

Fig. 4 – Numerical BEP representation; Annual Costs and Revenues vs. Annual Production volume

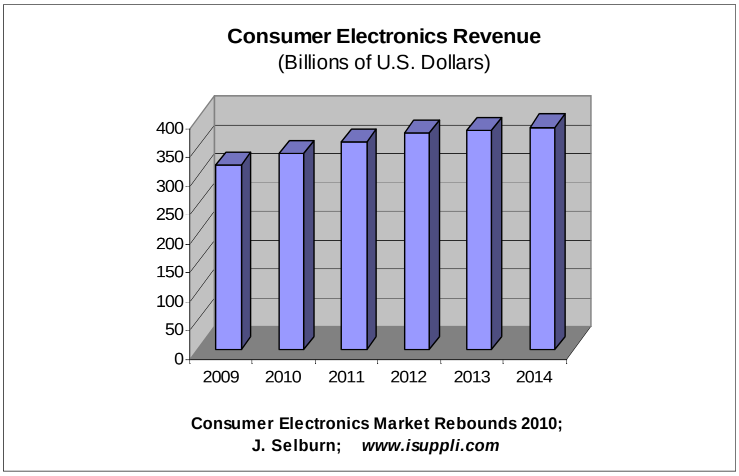

Fig. 5 – Consumer Electronics Revenue

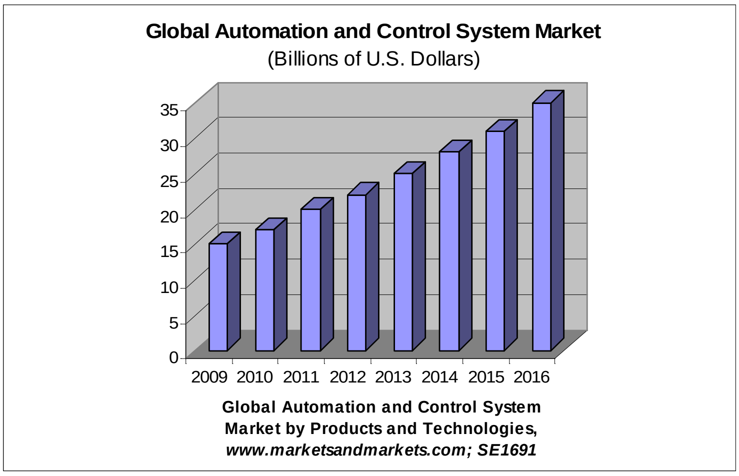

Fig. 6 – Global Automation and Control System Market

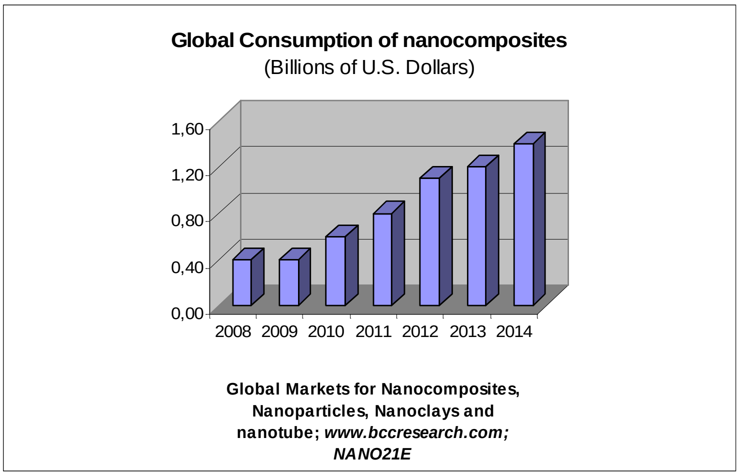

Fig. 7 – Global Consumption of nanocomposites

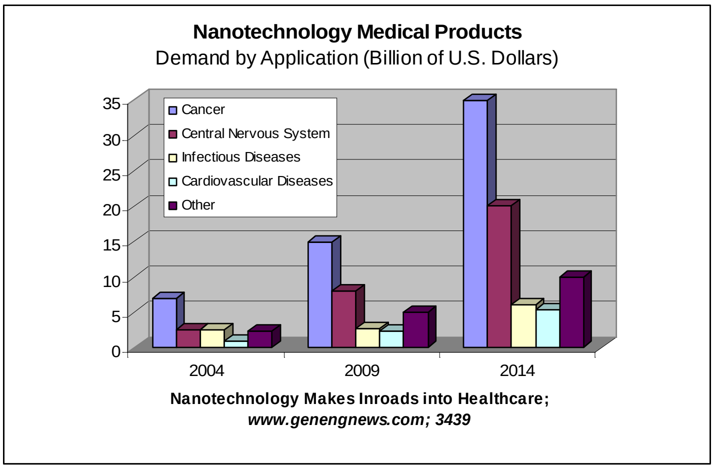

Fig. 8 – Nanotechnology Medical products

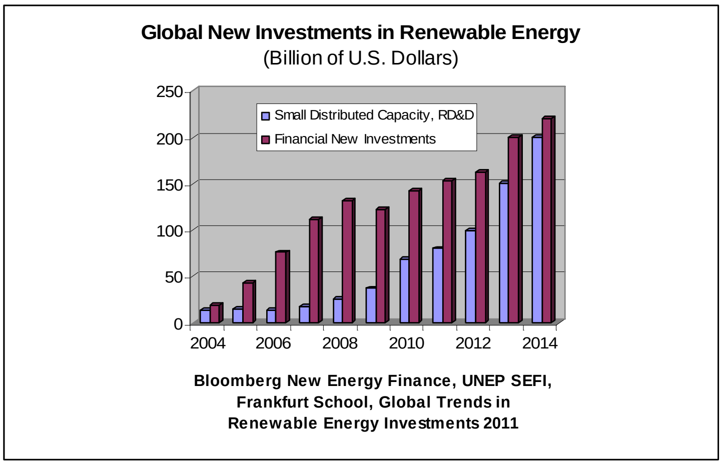

Fig. 9 – Global new Investments in Renewable Energy

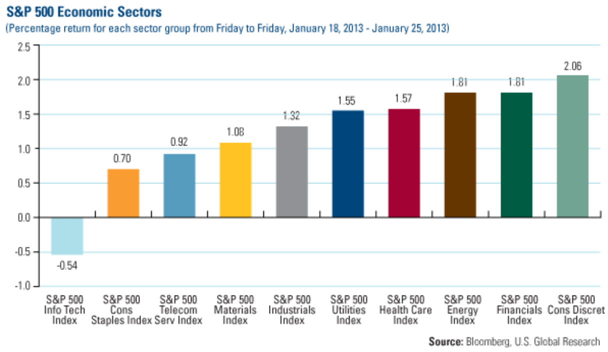

Fig. 10 – S&P Economic Sectors, percentage return for each sector group

N°	Sector	Description	Acronyms
1	***[Electronic]***	Data Acquisition and Processing System	(D.A.P.S.)
2	*[Electronic]*	*Devices Advanced HID and LED Lighting.*	*(D.I.L.)*
3	*[Electronic]*	*Electrical Drives for Electric Vehicles and boats.*	*(E.D.E.V.)*
4	*[Electronic]*	*Development of Fluorescent Sensors.*	*(D.F.S.)*
5	*[Nanotech and new mats]*	*Treatment and Sintering of Powders of mixture materials*	*(T.S.P.)*
6	*[Nanotech and new mats]*	*New Composite Materials in polymer matrix*	*(N.C.M.)*
7	*[Nanotech and new mats]*	*Realization of Nanocomposites for Development of Sensors*	*(R.N.D.S.)*
8	*[Nanotech and new mats]*	*FRC materials usable for damping of vibrations*	*(New F.R.C.)*
9	*[Energy and Environment]*	*Detection Parameters for the study of Environmental Air Quality*	*(D.P.E.A.Q.)*
10	*[Energy and Environment]*	*Artificial Systems for Solar Energy Conversion Photochemistry*	*(A.S.S.E.C.)*
11	*[Industrial Automation]*	*ABS Prototyping for fluid dynamics applications*	*(Mod.ABS)*
12	*[Industrial Automation]*	*Non-destructive testing (NDT) for experimental analysis of vibration*	*(N.D.T.)*
13	*[Industrial Automation]*	*Prototyping solid-state Sensor Systems in the Aerospace Industry*	*(S.S.Aero.)*
14	*[Industrial Automation]*	*Prototyping solid-state Sensor Systems in the Automotive Industry*	*(S.S.Auto.)*
15	*[Biomedical]*	*Prototyping solid-state Sensor Systems in the Biomedical Sector*	*(S.S.S.Bio.)*
16	*[Biomedical]*	*Multimodal Imaging Lab Activities*	*(M.I.L.A.)*
17	*[Biomedical]*	*Charybdis VACCINES Identification of new antigens*	*(Charybdis)*
18	*[Biomedical]*	*SCYLLA BIOTECH - Human Health and Biotechnology*	*(SCYLLA)*
19	*[Biomedical]*	*Biotech on Nanotech Diagnostic technology*	*(B.N.D)*
20	*[Biomedical]*	*New Biomedical Materials used in bone implant*	*(N.B.M)*

Table 1 - Results of technological scouting conducted at the University of Messina

Acronyms	Num. BEP	C1	C2	C3	Annual Costs	N pieces	Notes
(D.A.P.S.)	*1*	*0.6*	0.3	0.1	30.000	100	/
(D.I.L.)	2	0.5	0.2	0.2	60.000	100	/
(E.D.E.V.)	1	0.5	0.2	0.3	90.000	120	/
(D.F.S.)	2	0.5	0.3	0.3	50.000	80	/
(T.S.P.)	1	0.8	0.1	0.1	70.000	100	/
(N.C.M.)	/	/	/	/	/	/	Not really innovative
(R.N.D.S.)	2	0.8	0.2	0.2	40.000	100	/
(New F.R.C.)	/	/	/	/	/	/	Not ready for industrial appl.
(D.P.E.A.Q.)	2	0.7	0.3	0.2	40.000	50	/
(A.S.S.E.C.P.)	2	0.7	0.2	0.3	70.000	10	/
(Mod.ABS)	/	/	/	/	/	/	Not ready for industrial appl.
(N.D.T.)	/	/	/	/	/	/	Not really innovative
(S.S.Aero.)	2	0.4	0.2	0.1	60.000	500	/
(S.S.Auto.)	2	0.4	0.2	0.1	60.000	500	/
(S.S.S.Bio.)	2	0.8	0.2	0.1	60.000	400	/
(M.I.L.A.)	4	1.0	1.0	1.0	550.000	10.000	/
(Charybdis)	4	1.0	1.0	1.0	198.000	5000	/
(SCYLLA)	3	1.0	1.0	1.0	100.000	3000	/
(B.N.D)	/	/	/	/	/	/	Not ready for industrial appl.
(N.B.M)	/	/	/	/	/	/	Not ready for industrial appl.

Table 2 – Numerical BEP for 20 innovative proposal scouted in University of Messina

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Creating National Innovation Ecosystems Through Effective IP Management

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Abstract

Innovation ecosystems involve long term, collaborative relationships in areas of common scientific interest for mutual benefit. They can generate tremendous benefits from the transfer of skills and knowledge between businesses and academia. However, they can also be costly and difficult to establish and operate. One of the greatest challenges is the effective management of intellectual property (IP) in the collaborative research arrangements that underpin innovation ecosystems.

The evidence in this paper is drawn from work by Arthur D. Little's Technology & Innovation Management Practice with businesses, academia and Governments over the last ten years. Notably, this includes working with Ireland's national Government intermittently since 2005 to develop and refine Ireland's national arrangements for managing the IP created during collaborative industry-academic research. These arrangements provide the foundation for a national innovation ecosystem.

Early work in Ireland to create an initial set of national IP management guidelines in 2004-2005 was followed by extensive field research, with 78 stakeholders from 42 organisations, to understand the practical difficulties involved in applying the guidelines in 2008. This led to the appointment of two expert working groups, who we supported in their work to prepare a new national IP management policy and framework which was launched in mid-2012. Activities are ongoing to implement these new arrangements.

Issues identified through the field research and other from projects conducted by our group focused on a tendency to "reinvent the wheel" for every new agreement; difficulties in establishing the extent to research performing organisations (RPOs) such as universities and research institutes should be expected to provide warranties and other assurances that intellectual property rights (IPRs) arising from research are legally defensible, issues around assigning IPR ownership in multi-party collaborations, and a tendency by universities and RPOs to be incentivised by lucrative individual license deals, which in reality do not create an sustainable flow of knowledge transfer. Collectively these issues can make setting up the necessary IP management arrangements in an innovation ecosystem difficult and time consuming.

To deal with these issues, national IP management policies and guidance associated with creating and supporting innovation ecosystems must show a careful balance between rigid prescription and loose guidance. This balance cannot be decided by policy makers alone, and representatives from industry, RPOs and their technology transfer offices (TTOs) and research funders must be fully engaged with along the way, as was the case in Ireland. Policy and guidance needs to be tailored to country-specific factors, but also take into account common practice from other countries to ensure that those members of innovation ecosystems who operate across many countries can adapt their arrangements accordingly.

Whilst arrangements in Ireland now serve as an example of international good practice, they are not necessarily directly replicable in other jurisdictions. In this paper, we therefore set out practical guidance for what should be considered when defining IP management arrangements for an innovation ecosystem, drawing on Ireland's experience but made more generally applicable to industry, RPOs and Governments everywhere by drawing on our broader experience with other clients.

Keywords
Innovation, ecosystem, national, intellectual property, policy, framework.

1 Introduction

Governments and other public bodies have taken a close interest in innovation systems for many years. They have recognised innovation as vital for economic growth and a prosperous society and sought to adopt policy measures to stimulate it. They have seen the need to base policy on a sound understanding of how innovation works. Critical to this understanding is an appreciation of the role of communications and knowledge flows between the many different actors, including companies, universities and other public institutions. This emphasis on inter-actor relationships is at the heart of an innovation systems approach (OECD, 1997).

More recently, the term ‘innovation ecosystem’ has become frequently used. The concept is still emerging so definitions vary; for some, innovation system and innovation ecosystem are synonymous. We find it useful to use the term innovation ecosystem in a narrower sense, meaning a set of innovation actors with some common interest or purpose and a degree of continuity in their relationships. This is distinct from the diverse range of largely unrelated actors, with a variety of continuing and one-off relationships, in a national or regional innovation system. It is also distinct from an innovation cluster, which involves physical co-location of actors. An innovation ecosystem, in this sense, is characterised by mutual inter-dependence, continuous learning, the transfer of knowledge, and the growth of trust between the actors, all as a consequence of building up relationships over time and, in some cases, over international boundaries. It is founded on partnership and collaboration with other organisations, and is often based on the principles of open innovation (Chesborough, 2005).

Such a system can become self-reinforcing. For example, mutual trust is fundamental to a productive relationship, so an ecosystem environment can lead to more productive relationships which then encourage the members of the ecosystem to become more active participants within it. Similarly, the more that members of the ecosystem know each other, the lower are the transaction costs involved in setting up and in maintaining relationships, again encouraging greater participation.

Innovation ecosystems often involve a wide range of organisations. A **company** may build up and be at the centre of its own innovation ecosystem, which it operates as a “cloud” of external individuals and organisations which it maintains as a source of ideas and stimuli. Members of an ecosystem may include customers and end users, entrepreneurs, investors and in particular the public science base – research and technology institutes and universities, collectively termed research performing organisations (RPOs). We have seen increasing interest from companies to enrich their approach to open innovation and to develop more productive relationships by paying more attention to building a thriving ecosystem.

RPOs are increasingly working in partnership and collaboration with industry in innovation ecosystems. This is often because they are under great pressure to generate income, and that they realise the value of relating their research to real-world problems within the economy more broadly (Laredo, 2007). The innovation ecosystem approach encourages this, by making it easier for them to become known and trusted by industry and to be better positioned to understand industry needs and where they can add value.

From a public policy point of view, **Governments** are now seeking to stimulate the establishment of innovation ecosystems, attracted by the prospect of longer term and more productive relationships leading to more and better innovation, plus the potential for self-reinforcing ecosystem growth and hence an economic multiplier effect on the initial public sector stimulus.

Successful innovation ecosystems can benefit all of these actors, as summarised in Figure 1. Examples of such successful ecosystems, and the benefits realised within them, include the life sciences cluster in Cambridge in the United Kingdom, where an intense shared interest in the subject and dense formal and informal networks of relationship, all based on world class science, have led to one of Europe's top innovation hotspots. This is highly self-reinforcing, as demonstrated by AstraZeneca's recent decision to re-locate its main European research centre there (AstraZeneca, 2013). Elsewhere in the UK, the major aerospace companies clustered in the Bristol-Gloucester area (such as Airbus, British Aerospace and Smiths Industries), are at the centre of a rich web of collaborating suppliers and universities, and a similar cluster lies in the North West of England around companies such as Airbus, BAE Systems and Rolls Royce, which accounts for some 54% of the high technology jobs in the region (House of Commons Trade and Industry Committee, 2005). Brainport Eindhoven has become one of the top innovation centres in The Netherlands, accounting for a third of all Dutch private R&D expenditure and now one of Europe's top three regions in terms of patent density (Brainport, 2013). Another example is Rolls Royce's global network of University Technology Companies, long term relationships with university research teams across the UK who are trusted to provide the core of Rolls Royce's long term technological innovation. This example demonstrates that, unlike an innovation cluster, an innovation ecosystem may not necessarily be geographically co-located.

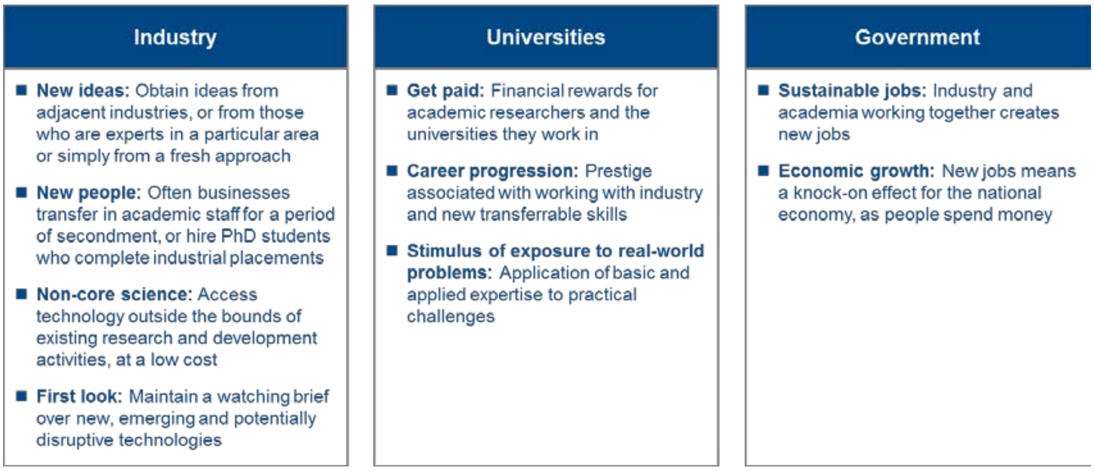

Figure 1: Benefits of ecosystem innovation (Source: Arthur D. Little)

The challenge for public policy is to create the necessary conditions for innovation ecosystems to flourish, and for these benefits to be realised. National and regional Governments often try to stimulate the growth of such ecosystems through the provision of people (e.g. support teams to help create linkages and networks) and money (e.g. in the form of funding programmes for collaborative research projects). An example of the latter is the Biotechnology and Biological Sciences Research Council-led Diet and Health Research Industry Club (DRINC), where Government contributes 90% of funding for a research project; a business provides the remaining 10%, and the research is delivered by a collaborating RPO (BBSRC, 2013).

Governments are also increasingly aware that another core enabler of an innovation ecosystem is an effective system for the **management of intellectual property rights (IPRs)** associated with the innovations arising from the collaborative development which takes place in an innovation ecosystem.

Sound IPRs are necessary to ensure that there are rewards, financial or otherwise, for all the parties in the collaborative innovation relationships found in innovation ecosystems.

Without these rewards, the mutual interdependency that exists as the core of an innovation ecosystem collapses. IPRs, such as patents, provide a temporary right of exclusivity to encourage the parties to commercialise – and potentially gain economic value from – the innovation. Without IPRs, there is little or no incentive to form the collaborative relationship.

Whilst innovation ecosystems involve the transfer of people, skills and knowledge as well as technology, licensing IPRs remains the fundamental means of generating revenue and is especially relevant for an arms-length transaction between otherwise unconnected collaborators. Highly networked systems can create great complexity in doing this – and this paper sets out the results of work to develop IP management systems within innovation ecosystems and discusses some key elements which Governments and RPOs could consider taking into account when doing so.

2 Methodology

The results of this paper are based on a number of projects delivered by Arthur D. Little's Technology & Innovation Management Practice between 2005 and 2013. This has involved work with individual research institutes such as the Kuwait Institute for Scientific Research and the science and innovation centres of blue chip corporations, to define innovation processes and introduce open innovation principles. This has included companies such as Tate & Lyle, Borealis and Colt Telecom.

In particular, it has also involved work with Ireland's Government at various times since 2005 to develop and refine national arrangements for managing the IP arising from RPOs, particularly in instances where this involves collaboration with industry – arrangements which provide the foundation for a national innovation ecosystem (DJEI, 2012).

Following early work by ourselves and others to create an initial set of national IP management guidelines (Forfás and the Irish Council for Science, Technology and Innovation, 2004, 2005; Commercialisation steering group, 2006), we conducted an extensive programme of field research during 2008, with 78 stakeholders from 42 organisations representing industry, academia and public administration, to understand the practical difficulties involved in applying the guidelines.

The field work was preceded by a systematic breakdown of key questions into a mutually exclusive, collectively exhaustive set of likely issues, based on our previous work for companies and governments elsewhere and on our previous work on the initial set of Irish guidelines. This issues analysis helped to structure the field research to ensure it would be productive and comprehensive. The research itself included individual face to face interviews and round table consultation meetings in various parts of the country, followed by feedback sessions at which we tested emerging findings.

The conclusions from the field work led to the Government appointing two expert working groups, representing industry, academia, the national innovation support agencies and the Government itself, to prepare a new national IP management policy and framework. Our team supported the working groups to reach consensus on a wide range of policy, commercial and technical issues, including those identified in the field research. The new policy and framework were launched in mid-2012. Activities are ongoing to implement these new arrangements.

3 Results

Our results highlight the main issues which have arisen from our project work concerning IP management in innovation ecosystems. These issues were all strongly present in the field research in Ireland and are also apparent in our other work, where referenced. Our main findings were as follows:

Collaborative research agreements can take a long time to set up, such that the commercial opportunity may have passed they are in place: A frequent concern from our clients is the time taken to "do the deal" when setting up a collaborative research agreement - and especially in instances where more than one party is involved, as is often the case within an innovation ecosystem. This creates a risk that the commercial opportunity may have passed before legal arrangements can be completed – especially in fast-moving sectors such as ICT. This can be attributed to three main factors. Firstly, there is a tendency amongst collaborators to "reinvent the wheel" from one collaborative research agreement to the next. Secondly, deals involving larger or multinational corporations with centralised legal departments can reportedly be delayed for long periods whilst waiting for the company's legal team to find time to deal with the collaborative research agreement. Thirdly, the collaborating partners may arrive at the negotiating table with their own standard terms, such as those associated with IP ownership or licensing conditions.

This observation affects many organisations – including those who are considered leaders in this area. Cambridge Enterprise, the established and successful technology transfer office (TTO) at Cambridge University, can take anywhere between a week and six months to complete a deal from the point where a potential partner company is found and a relationship established (Willey, 2009). Microsoft specifies on its website that licensing activities can take anywhere between 3 and 12 months to arrange (Microsoft, 2013).

It is not always clear around the extent to which the integrity of IP arising from RPOs should be assured, nor who should provide this assurance: Opinions diverge considerably as to who is responsible for assuring the integrity of IP arising from the work which is conducted within research RPOs as part of an innovation ecosystem.

A particular issue focuses on the extent to which RPOs should be expected to warrant that the IP is "clean" in terms of the extent to which it infringes a third party's IPRs, whether it may have been disclosed prematurely, before the IPRs can be protected (e.g. by publishing the results in a paper or disclosing them at a conference before a patent has been filed).

A further issue concerns the extent to which such warranties and liabilities should be offered at all. Some consultees as part of our work in Ireland indicated that that they would usually seek to establish a non-disclosure agreement at the outset to ensure no leakage of new ideas and would check the integrity of the IP themselves, a view shared by those from the venture capital community. Others, particularly from the software domain, took it for granted that the IP may be compromised in terms of its integrity (e.g. through containing open source material) and accepted that they would take the kernel of an idea forwards themselves, developing it in-house until they were sure it was robustly defensible.

In instances where warranties and liabilities are offered or expected, a huge amount of work can be created for TTOs who are often tasked with commercialisation activities – and further difficulty and delay in negotiating commercialisation agreements. The situation also creates a fear amongst TTO offices of leaving the RPO exposed in the event of a high value licensing deal going wrong and a desire to make any transaction as watertight as possible, even on occasions where the IP involved pertained to basic research with little immediate commercial value. The TTOs estimate that their efforts are split 80% on reactive work (handling IP agreements and negotiations and supporting partnership initiatives) and 20% on proactive work (IP scouting, building links with academics, marketing and engagement with companies, and training).

IP ownership issues can be difficult to resolve in some jurisdictions, especially for multi-party collaborations. Some national measures such as the Bayh-Dole Act in the United States prescribe that the IP resulting from publicly-funded research will always be owned by the academic party. In many other parts of the world, including in most of Europe, there is no such legal framework, so there is more ambiguity and room for negotiation. Open source measures have yet to fully resolve the IP issues of accepting donations from a wide community of unknown contributors. Contributors to Linux have been accused by SCO of stealing copyrighted or trade secret-protected source code from SCO's proprietary Unix implementation. While such potential infringement has been attributed to ignorance, others have suggested that infringing "stealth" IP could be deliberately donated to projects to sabotage their success (Cargill & Bolin, 2004, from West & Gallagher, 2004). Our work in Ireland supports these observations, and established that IP ownership issues can take a long time to resolve, especially in multi-party collaborations.

There is a tendency to overvalue some IPRs, especially those associated with basic research: Most patents are actually worth very little (Chesborough, 2005). Mowery et al. (2001) demonstrated that only seven universities in the US had a net return from patenting (that is offsetting the costs incurred in preparing and getting patents), that over 90% of the returns were linked to a handful of patents (less than five for most universities) and that nearly all these patents were in the human life sciences sector. Figure 8 (HEFCE, 2012) indicates that income from IP licensing deals alone is very low compared to other ways of working collaboratively with industry, such as through contract research and consultancy – which also contain measures to protect IPRs.

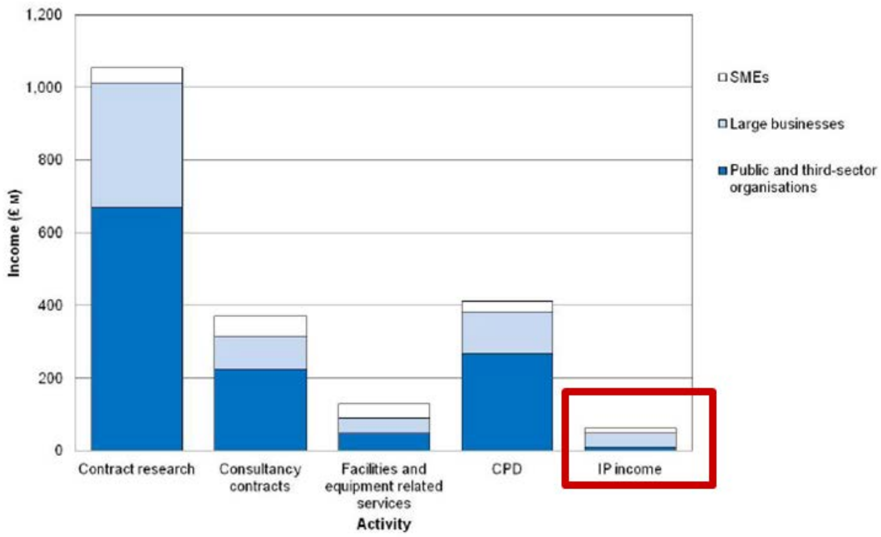

Figure 2: Revenue income to UK universities from commercial activities (2010-11)

In spite of these observations from others, our experience in working primarily with corporate innovation centres is that some RPOs see IP licensing as representing a potentially major source of income, and can have unrealistic financial expectations when seeking one-off license fees. One common observation is a fundamental difference in view about the role of a research idea in the commercial success of an eventual product. The inventor's view is that the idea is worth a great deal since, without it, there would be no product; the company's view is that the idea is worth much less, since commercial success depends primarily on the company's own efforts to develop and then promote the product. The effect of this perception is that the performance of TTOs within some RPOs is measured in terms of license fee income, which can discourage efforts to form longer term collaborations, as elaborated upon in our discussion.

4 Discussion

Policy makers who wish to stimulate vibrant innovation ecosystems, at national or local levels, should pay close attention to setting the right framework conditions covering the management of IP. These framework conditions may include tools, templates, rules and guidelines, as well as supporting institutional, financial, fiscal and legislative arrangements. It is apparent from the degree of frustration shown by those trying to deal with IP issues in collaborative R&D that the lack of appropriate framework conditions is a substantial barrier to building relationships and sustaining innovation.

Among the earliest countries to tackle the challenges of IPR management in highly networked systems was the United States which, through its Bayh-Dole Act in 1980, introduced legislation to regulate the ownership of IPRs arising from federal government funded R&D (Council on Government Regulations, 1999). Singapore has taken a similar legislative path. Some European countries have introduced guidelines, while stopping short of legislation: two leading examples are the United Kingdom (e.g. UK Intellectual Property Office, 2011, 2013) and Denmark (e.g. Confederation of Danish Industries et al., 2009) Most recently, Ireland has developed an advanced system of framework conditions, guidelines and support measures, which we believe represents current best practice (DJEI, 2012).

In interpreting our results, and in considering existing policies and frameworks such as these, three important lessons stand out.

First, **a careful balance between rigid prescription and loose guidance** is required. There is much to be said for fixed rules: for example mandating that ownership of IP arising from collaborative R&D which is supported by public sector money, even to a minority extent, shall always rest with the public sector partner(s) in the collaboration. Fixed rules remove uncertainty about the possible terms of a collaboration agreement; all parties know the rules before negotiating the agreement, so the agreement can be concluded quickly and painlessly. However, in practice there will always be cases where such a rule, applied indiscriminately, does not ideally fit the circumstances, may not match what the parties agree, and may even act as a disincentive to set up the agreement. Frameworks need to give clear guidance on what is mandatory and what is open for negotiation; on what is preferred, when terms are open for negotiation; and on what, if any, are the limits within which negotiation is possible.

The second lesson is that **determining where the balance between prescriptiveness and flexibility lies cannot be done by policy makers alone**. Thorough consultation with those involved, from both industry and public sector institutions, is essential to uncover the full range of views about what is desirable, and identify where there is consensus. Setting framework conditions in this way can lead to dramatic improvements: public sector institutions and companies such as Hewlett Packard in the Bay area of California were able to cut typical times to conclude collaboration agreements from two years to two months, by working together to create a consensus-based set of framework conditions (Burnside and Witkin, 2008). Where consensus cannot be reached, policy choices will have to be made.

These choices will differ from one country to another, as they will depend on country-specific factors such as the sector structure of industry (e.g. the ICT and biotechnology sectors may have different views on preferred IPR ownership and licensing terms); the maturity of the public research sector (e.g. universities with powerful and experienced TTOs may prefer relatively large amounts of negotiating freedom); and national industrial policy (e.g. a policy to favour foreign direct investment may require a different position on IPRs than a policy to grow domestic small and medium enterprises (SMEs)).

The third lesson is that **this need to tailor the national IP framework conditions to country-specific factors has to balance against the need for consistency, as far as possible, with common practice in other countries**. This is partly because multinational firms, operating in many jurisdictions, resist terms in one country that are markedly different from those they are used to elsewhere. It also minimises conflicts between the national framework and the terms of international schemes, such as the European Union's Framework Programme.

With these lessons in mind, we offer suggestions for some key elements of any national policy framework for IP management in innovation ecosystems.

Element 1: Help the parties to agree "ground rules" up front about how to work together, especially regarding IP ownership and access

The long term success of any collaborative relationship depends in part on all the parties agreeing, at the start, some clear ground rules for working together. These should include agreements on how IP is to be managed. Often, however, these IP agreements are missing, because the issues are seen as too difficult to resolve. Parties who do try to resolve them will often then be frustrated by the time it takes to do so. Policy frameworks therefore need to do more simply exhort; they must also provide help by indicating what the IP agreements should contain. Here, the issue of striking the right balance between guidance and prescription is especially critical.

An important instance of where policy frameworks can often help concerns the issues our work has identified around who owns the IPR arising from a collaborative research arrangement. Negotiations can quickly get bogged down in detailed discussion of who owns what, especially in the case of joint invention potentially leading to joint ownership of patents. Experience of both industry-public sector and industry-industry collaboration suggests that the real issue is to ensure the market and exploitation intentions of the partners do not conflict and that this can be better addressed by discussing the 'rights to use' IPRs, rather than focusing on ownership (Slowinski and Sagal, 2006). A frequently cited example of good practice in this area is Ireland's Innovation Partnership Programme, a collaborative funding mechanism which sets out unambiguous arrangements for ownership and for rights to use by all parties, to be agreed to before work commences (Enterprise Ireland, 2013).

Another instance where policy frameworks can encourage good IP agreements concerns how much detail (e.g. on license terms) should be agree at the start, when the results and their commercial value are largely unknown, and how much can and should be left until later. Whilst setting out the principles at the start is valuable, trying to finalise terms when the technology is unproven may be a waste of time (Mehlman et al., 2010) An overarching agreement of principles, leaving details to be decided case by case, is preferable (Science Business Innovation Board, 2012).

Element 2: Provide standard forms, templates and terms

Recognising the difficulties of preparing fresh agreements for each research collaboration in an innovation ecosystem, some Governments have developed national guidelines and standard templates. For example, the UK provides a toolkit, including guidelines and a series of standard agreements known as the Lambert Agreements, which cover both bi-lateral (one company and one research institution) and multi-party situations (UK Intellectual Property Office, 2013). Other standard models exist elsewhere - for example the EU Framework Programme model contracts, as well as national model agreements in France and Germany.

Universities in the United States often publish clear principles on their websites which potential licensees are expected to accept – principles that are largely consistent amongst the institutions, as they are framed by legislation such as the Bayh-Dole Act. Ireland’s new framework conditions stop short of offering standard texts for collaboration agreements but provide detailed guidance on what the agreements should say. Similarly, Denmark offers guidelines, while the European Commission has been working towards common guidelines to apply across Europe (European Commission, 2004, 2007, 2008). Even where national level guidance is not available, adapting approaches from other countries may save time and effort.

Element 3: Encourage the maximum utilisation of IP arising from a collaboration

Policy frameworks should encourage collaboration partners to maximise the use of IP, rather than leaving it “sitting on the shelf”, as other studied have found can often be the case, especially within businesses (Chesborough, 2005). This may include institutional arrangements such as a national IPR market and mechanisms to encourage and facilitate open information exchange; these are among the functions of the new central technology transfer office (cTTO) being created in Ireland. It may also include specific IP access and licensing terms designed to appeal to particular industry sectors or types of collaboration. The new Irish framework sets out provisions for non-exclusive, royalty free (NERF) licenses, awarded to companies who contribute financially towards a collaborative research programme with a public sector research organisation. Here, a company receives a NERF automatically for a short period to test and trial the IP, in order to decide whether they want to exclusively license it – for a fee. If not, the public sector organisation can seek another licensee. The system brings advantages through encouraging companies to make use of the IP arising from the research programme, as well as encouraging collaboration in the first place.

Element 4: Include measures which facilitate sustained knowledge transfer rather than a series of short term technology transfer deals

A characteristic of productive innovation ecosystems is their continuing nature and the repeated interactions between its members. Framework conditions should encourage public research organisations and companies to build long-lasting relationships with each other, rather than aim for the occasional one-off licensing deal, as our results show this creates greater value to the RPO. Such relationships can provide a continuing stream of income and insights into real-world needs, for the public research partners, and space to develop human capital and opportunities for deep knowledge transfer for everyone involved (Science Business Innovation Board, 2012).

To make such long term knowledge sharing relationships work, it is important that everyone involved clearly understands 1) what knowledge must be shared, 2) what may be shared under specific restrictions (e.g. concerning confidentiality) and 3) what must not be shared (Slowinski, Hummel and Kumpf, 2006). This should be covered in the collaboration agreement; the partners then need appropriate communications processes in place internally to keep their staff informed. National framework conditions should encourage both steps.

Element 5: Adopt appropriate metrics for technology commercialisation by RPOs and the TTOs within them

We observe, in Ireland and elsewhere, a tradition of measuring the health of industry-public research relationships in terms of numbers of license deals done, and the revenues incurred as a result. This shows itself strongly in the performance metrics frequently set for TTOs.

Shifting the emphasis towards long term relationships and knowledge sharing requires radical changes in metrics. In particular, metrics should cover a wide variety of types of industry-public research interactions rather than, say, just counting numbers of licence agreements.

Research in the UK has demonstrated that, in good quality relationships, academics and companies interact in multiple ways. Many of these are informal and small scale and hence largely hidden from view and ignored in the headline statistics on formal collaborations (Salter et al. 2010). For example, it is worth noting that the mission statement of Cambridge Enterprise, the technology transfer organisation of Cambridge University, puts disclosure and cooperative management of innovations ahead of earning money – and its financial mission is sustainability, not profit (Cambridge Enterprise, 2012). This illustrates the principle that the chief purpose of RPO IP commercialisation is public good – knowledge and technology transfer for the benefit of society – and not making money. That said, it is reasonable to expect established TTOs to cover their costs. This, howeve r, takes time. International experience suggests it takes at least ten years for a new TTO to build up its portfolio of IP and relationships to the point of financial breakeven (Cambridge and Stanford Universities are at this point).

Experienced technology transfer officers acknowledge that the optimum route to success in technology transfer is to grow the level of quality of the deal flow. This means that, rather than focusing only on achieving the maximum revenue from a single license deal, it is better to build strong and lasting relationships between individual companies and the TTO’s own researcher community. This is a longer term game but one that companies report is more likely to satisfy them and encourage further and deeper collaboration (Pertuzé et al, 2010).

Element 6: Provide appropriate central support for the innovation ecosystem generally, and TTOs more specifically

Certain functions, such as procuring expert legal advice, providing an IP market place, training in knowledge and technology transfer, and offering specialist advice for complex deals, may be more efficiently delivered through a cTTO than by being left to be done by – often very busy – individual TTOs within RPOs. A central unit can also ensure a degree of consistency in approach amongst a country's TTOs, something that industry partners welcome, and facilitate the sharing of good practices amongst TTOs. It should, however, remain in a support role and not interfere with the authority of the TTO to negotiate and complete a deal: to do so would create tensions between it and the local TTOs and make the support function harder to fulfil. An example is Ireland's cTTO, currently being set up, which will connect companies looking for specific expertise with the most appropriate RPO. It will also advise on what IP is already available for commercialisation. Once established, the opportunity will exist for the cTTO to expand its business-industry outreach role and provide support in complex, multi-party deals.

Element 7: Spell out the responsibilities of public research organisations for the integrity of their IP

A partner who wishes to exploit IP created in an RPO, for example by licensing it from that organisation, may want guarantees that the IP is properly owned by the organisation and is free from conflict with any other IP. Yet the organisation may not be able to give such a warranty, nor accept the potential liabilities were it to do so.

Rather than give guarantees, good practice (in the United States, for example) is for RPOs to take reasonable care to ensure the integrity of their IP as it is created, seeking external professional advice from patent attorneys as necessary. Industrial partners should expect RPOs to show that they have robust processes in place to ensure that the IP is clean; but they should not expect an absolute guarantee that this is so. Companies should assume the responsibility of conducting the due diligence required to ensure that the IP is sound. Indeed, many businesses' corporate policy requires them to do this.

We believe it would help to reduce the level of concern on this issue, and shorten deal times, for national framework conditions to describe the processes which the RPO should have to manage the integrity of their IP and to spell out a clear and common position statement setting out what, in the typical case, industry can expect public research organisations to guarantee, and what is therefore left to industry to manage. This position statement should specify any differences in approach for different fields of IP (for example, software versus pharmaceuticals) and any quanta of liability that the public organisations might accept in given types of situation.

Element 8: Ensure that collaborators have good IP management processes in place to underpin these assurances, and ensure that everyone is aware of them

In order to provide such guarantees, good IP management processes are required which demonstrate a reasonable level of IP integrity. Policies and frameworks can provide guidance on good practices in IP management processes – which, when followed properly – can help assure integrity, as well as identify more IP arising from RPO research, get more IP into the marketplace, and make relationships more attractive to maintain in the long term.

A good example of such a process is one which handles premature publication. A frequent source of tensions between industrial and public research partners is the industry partners' desire for secrecy versus the academic need to publish – and potentially invalidate IPRs by inadvertently disclosing the innovation (e.g. in a conference paper) before protection has been obtained (e.g. through a patent or non-disclosure agreement). We observe that risks of premature publication can largely be managed by ensuring that basic principles and procedures are in place in public research organisations to ensure that academic staff and students are clear about the circumstances under which they can publish. These might include, for example, a process for obtaining permission from other collaborators, with a default position to go ahead if no objections are raised, and a time limit (say six months) on how long an industry collaborator can block publication. To ensure this process works, staff and students must be aware of the importance of IP management up front. In some cases, it could be appropriate to ask them to sign an undertaking to indicate that they understand what is expected of them before they can draw down research funding, as is the case in Ireland.

A further issue surrounds the introduction and use of background intellectual property (any existing IP introduced to a partnership) which may have existing restrictions over its use (i.e. it has already been licensed to someone else). Here, standard background IP disclosure templates and procedures can be used to capture, disclose and manage any existing restrictions.

As well as providing processes, there is a need to ensure that they are followed – and there are several factors which may influence this. The most common is a question of incentives – are appropriate measures in place to encourage people to adhere to processes? Do they get something out of it, or are reprimanded for not following them? The next most common is education. Do collaborators – including researchers and principal investigators – understand the processes and principles associated with IP management? Have they had the process for approving publications described to them, for example? Finally, it may not be clear who is responsible for delivery of the process – whose job description does it lie in, and who is measuring their performance? These are all issues on which policy frameworks can encourage collaboration partners to adopt appropriate procedures.

5 Conclusions

Innovation ecosystems involve the transfer of skills, knowledge, technology and information through collaborative research, often involving a mixture of RPOs and industry partners. Despite their openness, they must be underpinned by effective IP management processes to ensure that they realise commercial gain, ensure that RPOs are fairly rewarded for their efforts and create an environment which encourages companies to participate.

National IP policies and frameworks have a pivotal role in supporting such ecosystems by providing guidelines, templates and – where appropriate – rules about what can be done in collaborative research. The situation in Ireland, and the significant efforts made by the working groups and others to develop the new *status quo*, should now serve as an example of international good practice.

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The Coproductive University: Education And Research In Coproduction With The Wider Community

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Abstract
Mälardalen University has a long history of a successful cooperation and coproduction with the industry and public sector in Sweden. This has eventually led it to become one of the leading higher education institutes in Sweden for excellent coproduction with different societal actors, both internationally and nationally. The university has through its coproduction activities become convinced of its value and of the wide range of opportunities it can bring to all parties involved. In this paper, we share our experience through some good examples both from research and education and discuss what is needed for successful and sustainable coproduction with industry and public sector.

Keywords
Coproduction, industry-academia cooperation, public sector, applied research and education.

1 Introduction

Mälardalen University (MDH) is one of Sweden’s major university colleges, with about 13000 students and 1000 employees. The university was founded in 1977, in response to an unmet need for more qualified labour in the industrial dense region of Mälardalen. One of the major contributors was ABB, a global leader in power and automation technologies that operates in about 100 countries, which provided the funds to recruit very first lecturers to the university. At that time, the company had several critical in-house training courses that were incorporated into the University's activities.

This strong link to industry has not only remained over the years, it has been further developed through numerous joint research and education activities, leading Mälardalen University to become a major player in Sweden when it come to excellent coproduction with the society. The university commits in its strategy to deliver research and knowledge for the benefit of society, aiming to be the leading HEI in Sweden for excellent co-production with different societal actors by 2016, both nationally and internationally (MDH, 2012). The university expects to receive a state commission as a pilot university in Sweden within the field of coproduction, and as such to give concrete support to other HEIs.

In this paper we present some of the main results of the collaboration and coproduction with companies as well with municipalities and local health care sectors. We address the extensive research and education cooperation with international giants such as ABB, Bombardier, Ericsson, SAAB and Volvo, which, in some cases, has eventually resulted in preferred partnerships and joint ventures. We discuss how we apply the industry cooperation concept in the field of education e.g., by developing joint curricula and delivering common courses, as well as how we use our partners to attract national and international top talents to our undergraduate and graduate programs. We also cover coproduction in research e.g., through joint research project and industrial graduate schools.

It is also our belief that coproduction with small and medium sized enterprises is very important. SME:s often lacks own research capacities and do not have the same opportunities to benefit from research and incorporate new knowledge into the business units, as the large companies with their own R&D departments. On the other hand, the relative value of the research results could be even bigger in SME:s than in large companies. In this paper, we discuss the experience of having the university and its activities as an engine and catalyst in a cluster to develop new business opportunities for SME:s.

Besides coproduction with the industry, we describe the university's extensive collaboration with the public sector, with focus on health and welfare. One example of excellent coproduction that is covered in the paper is the Social Contract between the university and the campus cities Västerås and Eskilstuna, which has an objective to create value for individuals, organizations and companies through active learning processes in an innovative and trustworthy interplay.

Further, we present some local and regional support structures for coproduction, such as centras for ideas development and products realization, company incubators, science parks, and collaborative project for strengthening and showcasing the regions industry. We discus how the academia, the private and public sectors participate together to create value and benefit by new knowledge for national and regional development.

The paper is organized as follows: First, in Section 2 it is described how we cooperate with our partners to assure quality and business relevance of our education. Then, in Section 3 concrete examples of coproduction with the industry are given, followed by Section 4 that discusses the coproduction with the public sector. In Section 5 some coproduction catalysators and outcomes are presented and finally, in Section 6 we discuss the prerequisites and key success factors for sustainable coproduction, followed by conclusions in Section 7.

2 Model of coproduction

Mälardalen University concentrate its efforts to develop research-based education as well as educational relevant research of value and benefit to society by means of coproduction and internationalization (MDH, 2012), as illustrated in Figure 9.

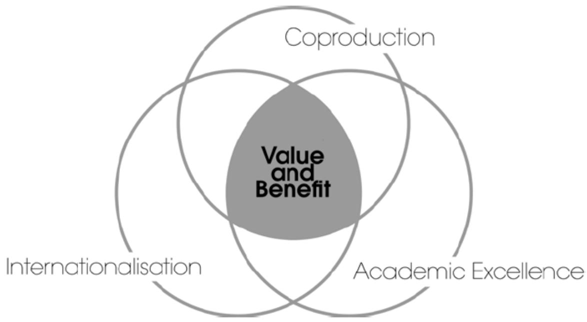

Figure 1: Mälardalen University's vision

For us, coproduction is taking the cooperation to the next level. It means working together on a long-term basis with companies and public sector for joint need, value and benefit, with joint competence, responsibility and contribution. Coproduction involves synchronized activities between the university, industry, society, health- care sector, social care, community service, educational system, municipalities, organizations and science parks, where all involved parties are responsible and active in achieving results (Meyer-Kramer, 1998).

With a basis in the current extensive and well-recognized research, graduate education, and industrial cooperation, we use several novel instruments for strengthening the industrial impact of research and education as well as speeding up transfer of technology and knowledge from research to industry. One such instrument is industrial PreDoc program packaged as two-years master programs, featuring both theoretical courses to prepare students for graduate education. It also includes and extended thesis work that will be performed as a joint effort between industry and academia. Concrete examples of such program will be given in the next section.

Another coproduction instrument that we use is Industrial PhD program, i.e., the doctoral students that are both employed by the company, usually 50%, and by the university. This is a way to ensure good transfer of technology and knowledge between the academia and industry. Currently, the university participates in three large industrial graduate schools with more than 40 industrial PhD students, which are described in the next section.

Industrial PreDoc and PhD programs are accompanied with the industrial PostDoc program. They include one or two years of post doctoral research performed partly in academia, partly at a hosting company, with the purpose of preparing the PhD for an industrial career and/or developing his/her research results into a successful innovation.

Moreover, we offer mobility programs with industrial stays for academic PhD students and researchers, as well as dedicated Industrial Guest Professor programs. Figure 10 illustrates the difference between the traditional approach and the approach of Mälardalen University (Isovic, 2009). The MDH approach integrates the university with the industry on several levels, providing more choices for the students and researchers.

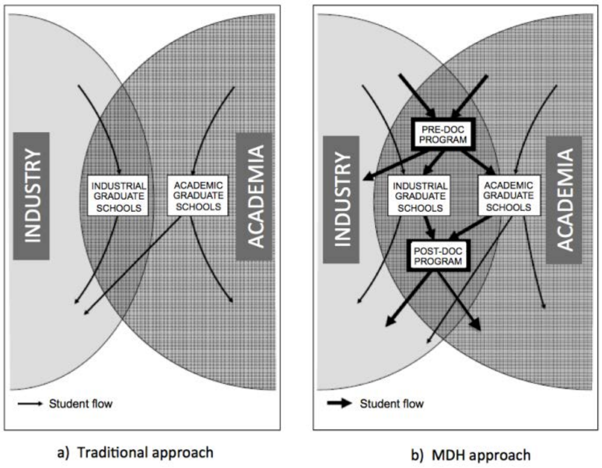

Figure 2: Coproduction instruments

Furthermore, the university initiates joint ventures for future workforces and participate in preferred partnership programs. Those initiatives, which are valid for several years, usually comprise joint research projects, degree and internship projects for students, and other common activities that are beneficial for both parties. The long-term partnerships further increases the opportunities of employment for MDH students, the opportunities for companies and public sector to recruit, and is a springboard for new research and educational projects. We will describe a couple of such partnership in the next sections.

To ensure long-term coproduction, to create and develop processes and models for co-operation, and to strengthen the university's relations with the surrounding community, a project called *openinnovation@MDH* has been launched. The project's primary focus has been to position and profile MDH regionally and nationally, to clarify the university offer as the coproducing university, and to create alliances and activities with various important stakeholders.

The next two sections describe the university's coproduction efforts from two different perspectives, the industrial and public sector respectively.

3 Coproduction with the industry

The model of coproduction with the industry is illustrated in Figure 11. The university provides courses for industry, students and staff for industrial theses and internships, while the industrial partners provide experience, equipment, guest lectures and research stays. Coproduction is performed in common research projects, workshops and seminars, steering groups and co-supervision of PhD students. We describe next some concrete examples of coproduction with the industry.

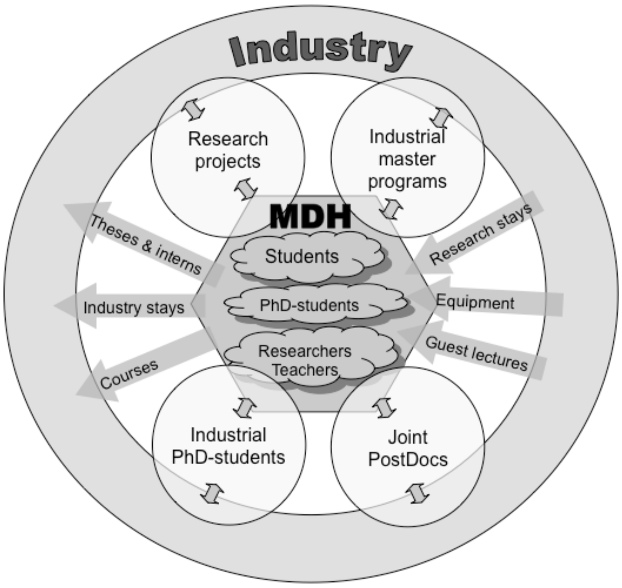

Figure 3: Model of cooperation with the industry

3.1 Joint research projects

Mälardalen University focuses on research that contributes valuable and useful solutions in coproduction with society at regional, national and global levels. Almost all technology research projects involve several industrial partners and the findings that emerge in our research can also be directly applied among our cooperation partners. A significant number of research project also lead to spin-off companies with the commercialization of research results.

External research coproduction has therefore become financially important for the university. As much as 65% of our total research budget is externally funded, in some specialization areas such as embedded computer systems, even 80%, which is among the highest in Sweden. For example, external funding received from Swedish Foundation for Strategic Research in recent years are the third largest in Sweden, and the funds received from Vinnova, Swedish's innovation agency, are the largest of all Swedish universities.

3.2 Industrial master programs

Industrial Master Programs is an example of the PreDoc initiative that was mentioned in the previous section. The goals are to significantly increase the supply of competent personnel for future recruitment to Swedish Industry, to increase the industrial relevance in academic education, and to prepare students for research education and research performed in close collaboration between industry and academy.

Such programs are designed in coproduction with several companies in the region, and they are coordinated with sector councils. Through these councils external key stakeholders obtain better insight into the on-going and future education. At the same time the participating companies also have the opportunity to influence the content of courses/programmes (Isovic, 2009, Lago, 2008).

Furthermore, students have good opportunities for internships, thesis work at companies, mentoring programs, job fairs, networking and guest lecturers given by industry. The large parts of industrial master programs are performed in a project form, where most projects are supplied by the industrial partners, and are solved in collaboration with them. This gives the student access to an important network already during their studies.

A report from the Confederation of Swedish Enterprise (CSE, 2012) shows that a strong industrial collaboration is essential for student's opportunities to succeed in the labour market after completed studies. It shows that a good collaboration with the surrounding community in higher education gives following benefits: i) increases probability for students having a job within three months by 78%, ii) increases students' chances to obtain a qualified job by 69%, and iii) it provides students, on average, 4.4 % higher starting salary. According to the Swedish National Agency for Higher Education (HSV, 2012), as many as 81% of MDH students find a job within their area of expertise within one year after their degree.

3.3 Joint recruitment of top talents

Since 2008, MDH runs a top-talent program with Ericsson and TATA Consultancy Services (TCS), India. Funded by industrial fellowships, the program offers a limited number of scholarships every year to recruit and bring top-talents from India into academic and operational excellence. The top-talent program gives the opportunity to study in industrial master programs, including industrial projects and internships with Ericsson and other industrial partners of MDH. To the best of our knowledge, this is a concept that stands alone in Sweden; no other university has worked internationally along these lines.

For this reasons, Ericsson has set up sophisticated equipment and complete development environments at Mälardalen University, called Industrial Research and Innovation Lab (IRIL). The IRIL lab allows for regular thesis works side by side with research projects, contract education for employees and personal management courses. The idea is to create an innovative multi-cultural environment and to create new points of cooperation between the participating companies. For the companies, IRIL offers several benefits. It is the arena where companies get help defining, running and managing theses. It is a place where industry and department can meet to share and exchange experiences and ideas.

3.4 Industrial research schools

Currently, the university hosts three large industrial research schools. Each of them involves a large number of industrial partners. The coproduction idea refers to partner companies gaining academic knowledge and access to emerging scientific results. These can be further used improving production or processes at an industrial scale thereby generating economic benefits. Swedish Foundation for Knowledge and Development is co-funding all three school, together with the university and the involved companies.

ITS-EASY is an industrial graduate school in embedded systems with about 20 industrial PhD students supervised together with 10 different companies. The school focuses on topics of paramount importance for domination parts of Swedish industry: embedded systems including software-intensive systems. ITS-EASY PhD-students are affiliated both with MDH and one of the participating industries. They will become experts in a selected research area, and will have experience of industrial development, ready to continue their careers as industrial specialists, innovators, or academic researchers – in all cases well aware of the academic and industrial environments.

INNOFACTURE is a unique doctoral program with 16 students in innovation and production started along with eight of the country's largest manufacturing companies. The aim is to strengthen Swedish competitiveness in the global market.

The industrial research school REESBE (Resource-Efficient Energy Systems in the Built Environment) is a collaboration of universities, building sector and energy utilities in three regions. REESBE includes 12 doctoral candidates, and the majority of them are working at the industrial partners companies, of course in close collaboration with the universities. In this way the industry obtain maximum feedback from the joint research efforts and has a possibility to include research finding in the organization.

As an additional example in this context, the coproduction initiative PREPARE should be mentioned. In 2008, many Swedish companies were heavily affected by the financial crisis, leading to major cutbacks, especially among the employees. One of those companies were Volvo Construction Equipment where several skilled staff were facing unemployment. Individual risked to lose their jobs and the region risked to lose important competence. In those tough times, Mälardalen University took the initiative to PREPARE, a unique project where the Volvo employees could start as industrial PhD students and do research at their company instead of losing their jobs. When the crisis was over, they could go back to their jobs with new knowledge (Röding, 2012). The university was praised regionally and nationally for reacting so promptly in the times of crisis, and the collaboration with Volvo CE was strengthened, leading to MDH as a preferred partner of Volvo, see the next subsection.

3.5 Long-term agreements

In 2013 the university has signed a unique cooperation agreement with ABB. The agreement comprises, among other things, 40 degree projects and 50 summer internships at ABB to be offered to MDH students each year. It makes the joint research projects easier to establish, making the efforts clearer, facilitating follow-up and creating more research projects. Furthermore, MDH and ABB also have the ambition of cooperating to increase the involvement and interest in technological issues among young people. An example of this is joint visits to upper secondary schools. The cooperation agreement between MDH and ABB is unique in its form since it is a long-term, strategic and broad agreement between academia and industry. Together ABB and MDH have not only produced an agreement but also a concrete method for how academia can cooperate in a structured way with a large international company.

Another long-term agreement that the university has entered is partnership with AB Volvo, also a global giant. The agreement is within the two of the university's prioritized areas, embedded systems and product realization. The agreement includes a wide range of activities, such as short-term, exploratory actions, donations, joint research projects, coordination activities, etc. MDH is one of three Swedish universities that have been chosen to be a Preferred Research Partner of Volvo Group Academic Partner Program.

Besides the Ericsson top-talent program described above, long-term agreements and preferred partnerships is another way to recruit top-talents both to the academia and the industry. They attract the students by providing a wide range of activities with the companies, such as sharp industrial projects and internships. This year, the ABB/MDH partnership has been awarded the Best Recruiter Award at the Gold Dust event organized by companies in the region.

4 Coproduction with the public sector

Since the 1990s a growing expectation has been explicit that academic science should be utilized in the public sectors through collaboration. This is a new and different kind of collaboration with universities, with research and development in, not about, the public sector.

In Sweden, some universities, nearby municipalities and county councils have chosen to formalize their interoperability through special agreements with a focus on common strategic objectives, in some cases with a staffed organization that coordinates joint research and development. One example of this formalized collaboration is the Social Contract located at Mälardalen University.

4.1 The Social Contract

The Board of the Social Contract (SC) adopted the autumn of 2009 a vision and overall objectives for SC, founded in cooperation on equal premises. The vision is: "Eskilstuna and Västerås is a strong region that creates value for individuals, organizations and businesses through active learning in an innovative, trusting interaction." The agreement covers four years of operation in the years 2010 – 2013. The aim is to raise the level of competence in the region, including joint research & development projects that create evidence-based municipal work, improvements and innovations, customized training and venues for learning. There is a board with two representatives from each party, four sector groups; where more operational work is conducted and a process manager-line based on the university. The four sector groups have different focuses: Education, Care of Older People and Social Work, Future Work and Sustainable Urban Development (Röding, 2012).

4.2 The mission

The SC works from five different perspectives:

Operational activities with joint projects, structure building and seminars and conferences all for long-term collaboration;

- Policy Creation where SC is a venue for the university and public sector leaders in strategic discussions concerning higher education, research and the future need of competent employable persons;
- Learning – SC tests and develops models and methods for collaborative learning;
- Meeting places – SC coordinates contacts and is a link between the university and the municipalities in the region and finally
- Brand – SC should be characterized by professional collaborations that create benefits, a good example of the universities co-production.

4.3 The Social Contract 2013

The Social Contract is funded by the partner municipalities and Mälardalen University. The agreement is that the partner municipalities contribute with money, over four years, and Mälardalen University contributes with a similar amount in “in-kind”. A continued four-year period is planned within the areas illustrated in Figure 12.

Figure 4: The Social Contract 2013

When discussing collaboration questions benefits often appears, the settlement of SC is manifested that in January 2013: the sector Education has been transformed into a part of MKL, Mälardalen Competence Centre for Learning implemented in the University's School of Education, communication and culture. The sector Care of Older People and Social Work, has similarly been transformed to the Mälardalen Competence Center for Health and Welfare, implemented in the School of Health, Care and Social Welfare. Two other areas are the development area of Health technology and the area of cooperation; Sustainable urban development and Future work.

SC has created some popular and well-attended venues, such as annual thematic conferences and increased relationships between the involved municipalities and the university are highlighted in evaluations, in all partners' organizations and on all organizational levels. This has resulted in better understanding of each other's activities and organizations.

5 Coproduction catalysators

Today, there are several large co-production initiatives at MDH, where academia, the private and public sectors participate together to create value and benefit by new knowledge for national and regional development. A common denominator for the co-production initiatives is to shorten the pathways between research and innovation, commercialization and industrial use in order to enable regional growth. It is a firm belief that a suitable balance between different types of organizations, such as larger industrial companies, flexible SME's and innovative start-ups is important for the regional as a whole. In the following text several initiatives/structures are presented more in detail – all with the university as a driven coordinator and/or partner.

5.1 Company incubators

The innovation and commercialization process in the region is an additional example of collaboration between university, municipalities and other stakeholders both industry and public bodies. To strengthen the development of further cooperation and coproduction with the industry, the university has launched Centre for Product Realization, with the aim of developing effective models and processes to support the companies and other actors in their development of the next generations' products and services, and to give the prerequisites for innovation, competitiveness and growth in our society. Students carry out a large number of joint projects with the region's employers directly by means of projects in several courses coordinated via the centre.

The Centre for Product Realization collaborates closely with another unit of the university, the Idea Lab, a business accelerator that provides support to students and employees who would like to put their ideas into practice. Idea Lab, with its motto "good ideas need good company" offers professional help to start-up a company, by providing networks, industrial partners, mentoring and facilities. Idea Lab picks up the ideas and needs of external partners in order to refine and realize them. Moreover, the lab organizes contents, business idea competitions, workshops, happenings and inspirational TEDx events. The university has decided that each student should come in contact with Idea Lab at least once during his/her education. Idea Lab at MDH generates about 25-30 new companies per year, more than any other Swedish university.

5.2 Science parks

The university's two campuses are situated in Eskilstuna and Västerås with two separate science parks. The science parks are strongly supported by the cities. Västerås Science Park has focus areas in line with the university's strong research areas: automation, energy, IT and industrial design. It also operates a business start-up program named Kickstart, which includes development of own business ideas with guidance from more senior entrepreneurs, see Figure 13.

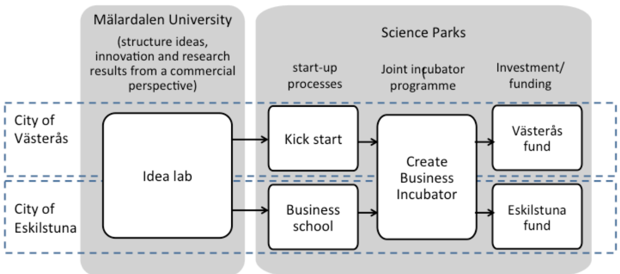

Figure 5: Company start-up

Through the diversity of companies future entrepreneurs will have an extensive network after completing the programme. In Eskilstuna, Munktell Science Park offer a similar opportunity through the Business School concept. The goal is to stipulate the best and most effective way to help entrepreneurs to develop their businesses and realize their new business ideas. The Business School gives the entrepreneurs a complete assistance in developing the business plan.

Both science parks jointly have the Create Business Incubator programme. Create offers entrepreneurs and researchers in the county councils of Södermanland and Västmanland a business development support that with fast and more reliable growth in mind. Create should be seen as a complementary instruments in the market. The incubator do not directly compete with existing companies in business development since the participating companies (start-ups) initially have little or no ability to pay. Create is a non-profit organization and generates no profit to the owners who consists of public bodies.

Both regions also provide funding opportunities through the county funds. The funds should be seen as complementary instruments to existing business angels, venture capitalists and other financial institutions and they both have support from public bodies such as municipality, county administrative boards and regional associations.

5.3 Susbiz

Through University's commitment in Sustainable Business Mälardalen (Susbiz), small- and medium sized companies are involved in research and development projects. The university founded Susbiz in 2006, supported by Chamber of Commerce. The vast majority of members are small-and medium-sized businesses. In total there are over 70 SMEs coupled to the cluster. Generally, smaller companies have limited resources in terms of both research and development. Also majority of the SME's primary are focused on regional or even local markets, and even with solutions that would be suitable for different international markets their competence and experience of complex and inter-cultural projects are limited. Through Suzbiz the universities act as a catalyst clustering competences from different SME's with experts from the university in capacity building networks – which in Susbiz is named as strategic alliances.

The value lies within the intersection of research, business development and taking project to new markets. The outcome is encouraging with several ongoing projects such as rural electrification and development with a sustainable village concept. Between 10-15% of members have concrete business cases through the Susbiz cluster.

5.4 Robotdalen

Robotdalen (eng: Robot Valley) is a Swedish robotics initiative enabling commercial success of new ideas and research within robotics and automation. Robotdalen focus mainly on solutions for the industry, heavy autonomous vehicles and technology for independent life. The goal is to develop new robotics innovations from prototype to complete product. Cooperation is conducted with prominent companies, robotics suppliers, start-ups and universities to achieve increased growth in the field of robotics. Bringing people together in flexible teams to develop new solutions in innovative projects is a key factor. Research and development projects are implemented by small and medium-sized companies, hospitals, global companies like ABB, Volvo, Atlas Copco and ESAB, and Swedish universities such as Örebro University and Mälardalen University.

5.5 Automation Region

Automation Region is a collaborative project for strengthening and showcasing the regions world-leading automation industry and our substantial automation and production know-how. Automation is a Swedish future-oriented field of considerable importance for competitiveness and for the big questions concerning resource usage, energy and the environment. Automation encompasses all systems relating to measurement and control of production processes, with the focus on productivity, quality, environmental management and human interaction. Together and in close collaboration with academia and the public sector, companies gain many advantages through the Automation Region. Several world-leading companies in the field have development centers in the region, there is a remarkable amount of expertise in the automation field in the region that extends from Stockholm to Örebro, and from Eskilstuna to Uppsala.

5.6 minSTInnovation

The purpose of minSTInnovation of Mälardalen is to support small and medium-sized enterprises to translate new knowledge in embedded systems in their operations. The overall mission of minSTInnovation is to develop small- and medium-sized corporate skills in micro- and nanosystem technology in order to renew product range for increased competitiveness, to promote knowledge development in universities, colleges and research institutes within the technology area: Also to develop knowledge exchange between SMEs', universities, colleges and research institutes and also with regard to international stakeholders. minSTInnovation supports SMEs with development skills referred to the company's understanding of technology opportunities and experience to implement such technologies. This supports an understanding of how such new products and services might come to affect the companies own organization in contribution to increased knowledge dealt in and create competitiveness for the company.

Figure 14 illustrates the relationship between the university and the above-mentioned initiatives. The coloured marking shows the main target of each initiative. For example, the idea lab is hosted by MDH and it extends the cooperation to the science parks (as illustrated in Figure 13).

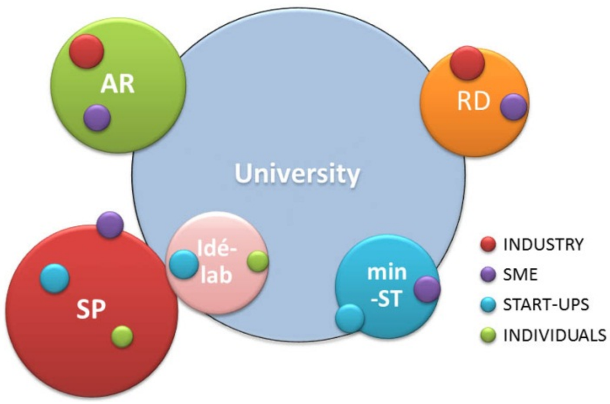

Figure 6: MDH and its surrounding

6 Coproduction prerequisites and success factors

In this section we discuss different prerequisites for coproduction with the industry and the public sector and present some, in our opinion, important factors for successful coproduction.

6.1 Coproduction prerequisites

One important aspect is the historical perspective. Coproduction with the industry has a long history. As mentioned before, the ABB company can in many aspects be considered as the groundwork of the creation of the Mälardalen University. On the other hand, the educational programs aiming at the public sector, such as nursing, social workers and public health, were established as governmental educational programs at the university only in recent years. The coproduction with industry has been iterated over many years while the coproduction with the public sector is still in its first run.

In this context, even the staff history is important. At the university units that cooperate with the industry, it is quite common that the staff has a long industrial experience, or still work part-time at the companies. This is not a case for professors in the area of health and welfare. Though, they usually have a health care or social welfare professional background, when leaving this for the university and/or research career, many professors abandon the profession and "clinical" engagement.

Another difference between the industry and the public sector is the motivation for coproduction. When considering the meaning of cooperation with the industry, profit is a major motivating factor. This is seldom the case in the public sector, which is tax funded and runs without profit demands. Instead, knowledge development, organizational learning, citizens' satisfaction are the main driving forces. Another motivation is "good will", i.e., to build the specific municipal value to increase the number of people moving to the region.

A final aspect to discuss is the political power system in the public sector, since Sweden have governmental and municipal elections every fourth year. Long-range collaboration could be effected if political majority in the municipal election changes. This is also an important difference to consider when discussing collaboration and coproduction and comparing industry, SMEs and the public sector.

6.2 Coproduction success factors

Understanding and acknowledging the interdependencies is very important for successful and long-term coproduction. University's history has contributed to its profound understanding of regional needs as its first educations were inherited from industry and elaborated into academic courses. The regional anchorage has been kept through customized sector councils. University was founded to meet regional needs of skilled labor of its international recognized strong industry. University, on the other hand, needs a close partnership with the society to bring the industrial relevance to its education and research. Moreover, the support from industry is needed to scale-up its limited governmental research grants. These dependencies partly explain why MDH together with regional partners has been one of the most successful universities in Sweden in both collaboration and coproduction.

Another important success factor is university's vision and firm belief in coproduction that is supported on all levels in the organization. For a long time, the university's position on coproduction issues has been clear. The implication has been developed and refined in research and education strategies over the years, and further on through the operative planning. The combination of supportive actions at management level and acceptance at the implementation level gives a significant momentum. Now, MDH has requested a targeted government mandate to develop a model for coproduction that could serve as a road model for other Swedish universities. These important signals from the university management along with its long traditions of industrial collaboration have given a solid base for trust and confidence – which is crucial for joint coproduction initiatives.

Moreover, the coproduction is strongly supported by the internal structure of the university. MDH has abandoned the traditional departments with single or closely related subjects, and it has organized itself into larger interdisciplinary units, school, with thematic focuses. This way, it becomes easier to use synergies between the subjects and to benefit from to benefit from different experiences. As an example, we can mention a recent research profile at the university, ESS-H, Embedded sensor systems for health, with a goal to increase life expectancy and to prevent accidents and to intercept illnesses before they become too serious. The profile includes several subjects at the university, such as computer science, electronics, biomedical engineering and health-care. Without removing the barriers between the old departments and allowing for internal cooperation and coproduction, this would not be possible.

The geographical location is also a significant parameter. As a regional stakeholder in a heavy industrialized region, the university has become important coordinator and/or partner in several coproduction initiatives, see Section 5, where the university fulfills an important role for regional growth and the creation of new businesses.

We would also like to highlight the industrial research schools as a important contributors to the coproduction at our university. To have coproduction through jointly employed doctoral candidates who work dynamically in both academic and industrial sector is very successful. Research results can be put into practice in early stages. Further, a continuous stream of information is transferred between the academia and industry.

An important success factor for us was the university's efforts in the previous recession. In order to prevent unemployment and losing skilled employees, the university organized a training program in which they could continue develop their skills. In this way, the industry was not only able to retain its competent staff until the state of the affairs was improved – they had a better trained work force improving company's competitiveness.

Trust and confidence between the coproduction parties is also very important in order to build a successful collaboration. It is perhaps not surprising but nonetheless worth mentioning, because the interacting actors, in varying degrees, have been working actively with different confidence-building activities. To work persistently and long term is also important. Collaboration needs cultivation and consumes time; cultivation is needed even in times of adversity. Moreover, an important factor is the parties' interests in each other, to interact, to learn and appreciate each other's differences, and to explore common visions and goals, searching for what unites rather differs.

At last, for the public sector example, our experience is that the composition of the board, is very important in giving legitimacy on political or highest official level for collaboration and coproduction.

7 Conclusions

Mälardalen University has a strong profile of coproduction with society, trade, industry and public sector, with many years of experience in developing working methods within that setting. The aim of the university is to produce, with its partners, outputs for societal benefit and value for all. This ambition covers all the different layers and activities within the university from basic and advanced education to doctorial education and research.

This paper presents a number of initiatives that illustrates how Mälardalen University continuously have been elaborating the coproduction concept at different levels, from leading management positions, via research and education activities, ending with initiatives driven by research groups and individual employees.

We describe the coproduction model mostly between industry and university, as the one with the longest history, followed by successful examples of coproduction with the public sector with a shorter history but significant impact on the university and the society.

Finally, conclude that coproduction must be flexibly executed, with respect to different coproducing partner organizations. We discuss the differences between the coproduction with the different actors, industry and public sector, and highlight the key success factors for long-term partnerships, such as mutual understanding, trust and confidence, internal strategy and organization, and innovative ways of conducting graduate education for the benefit of all.

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New Organizational Arrangements For Public-Private Research Collaboration: Cooperative Research Centres In Spain

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Abstract
This paper analyses the funding structure of Cooperative Research Centres (CRCs) in Spain using a sample of 123 CRCs. We aim to determine the effect of the effect of the degree of intersectoral collaboration on the CRCs' funding portfolio. We characterised CRCs ─ "market-oriented", "academic-oriented" and a "government oriented"─ according to the degree of involvement of each sectoral actor in diverse organisational aspects ─ setting their objectives, executing the R&D, and establishing the managerial processes and evaluation practices. We find that CRCs with "market oriented" characteristics rely less on public competitive funds and CRCs with "academic oriented" characteristics have a more diversified funding portfolio.

Keywords
Cooperative Research Centres; public-private Cooperation; Funding; Spain.

1 Introduction

The collaboration of public and private sectors in the funding and execution of research is increasingly important for developed countries. European countries and policies have acknowledged this need. The Europe 2020 strategy recognised it by setting the 3% R&D target, promoting an increasing share of private funds and promoting public-private research collaboration (EC, 2010a and EC, 2010b). An increasing share of private funds for research and public-private research collaboration is supposed to facilitate knowledge transfer, innovation and create economic growth.

Within this "cooperative technology policy paradigm" (Bozeman, 2000), Cooperative Research Centers (CRCs) emerge as important public-private research actors. CRCs are organisations that join public and private R&D actors ─ universities and research organisations, private firms and public administration ─ to carry out collaborative market-oriented research areas of industrial relevance (CREST, 2008). This collaboration encourages diverse sectoral actors to undertake new research challenges. On one hand, this collaboration pushes firms to carry out more ambitious innovations. On the other hand, this makes research partners to undertake more applied lines of research. CRCs facilitate the use of science and technology to tackle social and economic challenges that private companies research actors a government cannot easily address separately (Boardman and Gray, 2010: 452). Therefore, CRCs are key research and innovation actors that can facilitate economic growth.

Despite their importance, the understanding of CRCs is limited and framed within national borders and experiences. In Spain, as CRCs are recent and the result of a diverse set of initiatives at different administrative levels (national and regional), its understanding is even more fragmented. Our paper aims to shed light on CRCs in Spain by analysing the funding portfolio of CRCs and examining to what extent the degree of intersectoral collaboration has an effect on it. Funding strategies and structure are crucial for R&D organizations (Crow and Bozeman, 1987; Geuna, 2001; Lepori et al., 2007 and Aghion et al., 2010). To this end, we characterise CRCs according to their degree of intersectoral collaboration ─"market-oriented", "academic-oriented" and a "government oriented"─ and test if these have an effect on the CRCs funding structure. Using a database 123 CRCs, we specially focus on two funding sources ─ public competitive funds and funds from contracts and services to firms─ and consider other funding sources through an analysis of the diversity of CRCs' funding sources. We find that CRCs with "market oriented" characteristics rely less on public competitive funds and that CRCs with "academic oriented" characteristics have a more diversified funding portfolio.

This article is organised as follows: Section 2 introduces the theoretical background; Section 3 presents the hypotheses; Section 4 summarises the dataset, methodology and empirical strategy; Section 5 reports the results and Section 6 concludes.

2 Theoretical background

Current knowledge and innovation processes relies heavily on synergistic interactions among R&D actors and sectors ─ universities and research organizations, private companies and government. This trend entails to overcome the traditional frontiers between public and private sectors (Gibbons et al., 1994; Etzkowitz and Leydersdorff, 2000; Malerba, 2004). As a result, new social and organizational forces have emerged within current innovation systems as, for example, the collectivization of research, the emergence of a cooperative paradigm for research policy or the emphasis of open innovation strategies within industry (Boardman and Gray, 2010). In Spain, formal public-private research collaborations are also increasingly important within current innovation systems

In this context, the so-called "Cooperative Research Centers" (CRCs) arise as especially relevant actors. They consist of centres that join different public and private R&D actors and carry out collaborative market-oriented research on areas of industrial relevance (CREST, 2008). This may, on one hand, encourage firms to undertake more radical kinds of innovation, and on the other, help universities to initiate and perform new and more applied lines of research. Therefore, CRCs enable the use of science and technology to address social and economic problems that academic units, government actors and private companies cannot easily face unilaterally (Boardman and Gray, 2010: 452). It seems, then, that in the current scenario of European crisis, CRCs appear as key actors for innovation and growth.

CRCs are the result of national public policies and private initiatives. In United States, Australia and Canada, the emergence of CRCs began in the 1980s as a result of national policy program research on cooperative research. They have been evaluated by The Industry/University Cooperative Research Centers Program Evaluation Project (in the USA) and by the Industry and Innovation Studies Research Group (in Australia), and have been subject of extensive analysis (for example, Roessner, 2000; Gray et al. 2001; Gray, 2011; Garrett-Jones and Turpin, 2010; Turpin et al. 2005; Garrett-Jones et al. 2013 or Atkinson et al. 2001). In some European countries, like Austria, Norway, Sweden and, more recently, Ireland, similar policy programmes appeared in the 1990s and have been partially evaluated by consulting firms such as Circa Group and the Technopolis Group (Arnold et al., 2004). Although the understanding of CRCs is increasing, it is still limited and framed within national borders and experiences.

In Spain, formal public-private collaborations are more recent (since 2000s) and are the result of diverse initiatives at different administrative levels ─ national and regional (Fernández-Esquinas and Ramos-Vielba, 2011). At national level, we can find formal agreements and/or consortia between public research organizations and companies ─ for example, "Pharmacia" laboratory at the CSIC, INIA, IRTA or FIAB ─ and new centres with public and private partners, generally foundations ─for example, CNIO. At regional level, we can find some programmes inspired by foreign experiences ─ for example, in the Basque Country (Olazaran et al., 2009) ─ new centres, generally foundations, ─ for example, the CTTO in Catalonia ─ and already existing centres that acquire new missions ─ for example, some Technological Centres (Callejón et al., 2007). It is relevant to study the Spanish CRCs as they are an increasing a diverse phenomenon.

The study of CRCs in Spain is relevant as public-private research collaborations are becoming more important for current R&D systems and societies. It is crucial to understand the role of CRCs as new and diverse research actors. As R&D organisations, the understanding of CRCs requires to pay attention to their funding structure and strategy.

2.1 Funding and organization of Cooperative Research Centres

Funding structure and strategies are crucial for the development, performance and efficiency of R&D organizations. Crow and Bozeman (1987) show for a sample of public research laboratories that different sources of funding ─ public or private ─ lead to different research products ("generic products"- public goods vs. "appropriable products" for private use). Several studies on universities show that different funding mechanisms have evolved (Geuna, 2001; Bonaccorsi and Dario, 2007; Lepori, 2011) and are essential for the quality and effectiveness of their research. For example, Aghion et al. (2010)

show for a sample of European universities that a funding portfolio highly based on competitive funds enhances their research productivity, given a certain level of autonomy. Different sources of funding (public-private) and coming through diverse funding mechanisms (competitive funds) are important for R&D organisations strategies and performance.

The funding structure of CRCs is shaped by their "public-private" nature and the degree of governmental support. Direct public funds coming from the Cooperative Research Centers Program are central for Australian CRCs (Slatyer, 1994). However, more diversified and private source of funds characterise North American CRCs (Geisler et al. 1991). In Spain, there is evidence of a change in the funding structure of governmental laboratories and technology centres towards a more diversified and increased share of competitive public funds (Cruz-Castro et al., 2012). Due to their public-private nature, it is important to study the diversity of funding sources and funding strategies of CRCs.

The main characteristics and challenges of CRCs come from their "hybrid" (public-private) nature. CRCs have to deal with the different expectations, goals and research interests of the agents involved, ranging from research excellence and economic returns (Roessner et al. 1998; Lee, 2001; Santoro and Chakrabarti, 2001; Feller et al., 2002; Carayol, 2003). CRCs have also to handle changes in the traditional roles of the different sectoral actors, including R&D execution. Universities and research centres have to share the execution of R&D with firms. Tornatzfy et al., (2002) or Boardman and Gray (2010) find that big and high technological company partners are important R&D executors. In addition, management and evaluation practices have to deal with the requirements of different sectoral-actors. For example, Turpin et al. (2005) and Turpin and Deville (2005) point out this need in organising the career tracks and incentives of researchers that work at CRCs centres (Turpin et al., 2005 and Turpin and Deville, 2005). The degree of involvement of each sectoral partner in different organisational aspects of CRC's, such as, setting their objectives, executing the R&D, and establishing the managerial processes and evaluation practices, might determine the behaviour of CRCs.

There is an increase demand for research organisations to have a more diversified funding portfolio, coming from public and private sources and through diverse funding mechanisms. Due to the "hybrid" nature (public-private) of CRCs, it appears to be more relevant to understand the funding structure of these new research organisations. In order to study the diverse sources of funding of CRCs, it is relevant to pay attention to the degree of involvement of different actors. The degree of involvement of each sectoral actor in the CRCs organisation could lead CRCs to rely more in a specific source of funds, which in turn could affect to their performance and their opportunities to adapt to a changing environment.

Each paper should start with a short introduction stating the problem / knowledge gap addressed in the paper, the main goal of the paper as well as a short paragraph about the structure of the paper. Following this introduction, the main part of the paper should follow, e.g. literature review and empirical results or a detailed description of the approach in practitioner papers. Please structure the main part of your paper as it best suits your project. Both academic and practitioner papers should contain a section with the main results / findings followed by a discussion of these findings / results. Papers should end with a conclusion which might include a summary of the paper as well as its limitations, recommendations and suggestions for further research and action. The conclusion should be in harmony with the introduction. The full paper must be an understandable entity by someone that has not attended the session at the conference.

2.2 Hypotheses

In this article we want to test the following hypothesis regarding the effect of the degree of intersectoral collaboration on the funding structure of CRCs:

H1. A higher participation of universities and research organisations in the organisation of CRCs leads to a higher share of funds coming from public competitive sources. Since public funds are increasingly allocated through competitive mechanisms, we expect universities and research organisations to be more able to collect this type of funds. Therefore, CRCs with these characteristics ─ academic oriented ─ will be more successful to get this type of sources.

H2. A higher participation of the private sector in the organisation of CRCs leads to a higher share of funds coming from private sources. CRCs with these characteristics ─ market oriented ─ have more experience and are more able to collect private funds.

H3. The degree of intersectoral collaboration has an effect on the diversity of funding sources. A higher participation of the private sector in the organisation of CRCs could lead to a higher diversification of CRC’s funding structure. The profitable character of private actors could lead “market oriented” CRCs to be more skilled to acquire funds from different sources. However, it could also negatively affect the diversity of funding sources as these skills to acquire funds could be more specific to acquire funds from the private sector leading “market oriented” CRCs to rely more importantly on private sources of funding.

3 Material and methods

3.1 Data and sample

We use data coming from the research Project “Emerging Forms of Cross Sector Collaboration between Science and Industry: Cooperative Research Centres in the Spanish R&D System” (ES-CRCs) launched by IESA-CSIC in 2010. This is an on-going three years project that includes three surveys: to (1) cooperative research centres, (2) firms and (3) researchers involved in the centres. Here we report results on the first survey to CRCs.

In order to obtain our final sample we identified the whole population of CRCs. Due to the diversity of Spanish public-private collaboration initiatives carried out at different administrative levels ─ national and regional ─, there is not a complete directory of Spanish CRCs. Therefore, we mapped the existing R&D collaborative arrangements in Spain through a systematic review of secondary sources of data and web search.[1] We operationalized the description of CRCs, following the definition of Boardman and Gray (2010), as organisation that explicitly recognise:

› To have a formal structure and a separate legal entity,

› To conduct R&D activities and

› To have least one public and one private actor among their partners.

We reached a final population of CRCs in Spain of 163 centres. We sent the questionnaire using a postal/web mixed-mode technique (Diment & Garrett-Jones 2007) and telephone reminder using CATI system targeting to the directors of the centres or high-profile managers. On-line access to questionnaire has been opened from August to October 2012. We sent 6 e-mail and 3 postal remainders to the centres. We had a response rate of 75.46%, reaching a "strategic" sample of 123 CRCs.

Table I shows the geographical distribution of the population and sample of these centres. We didn't find a significant difference in the geographical distribution of CRCs between the population and our sample: all differences are inferior to 1-2%.

Region	**Population (n -%)**		**Sample (n -%)**	
Andalucía	31	19	25	20.3
Aragón	5	3.1	4	3.3
Asturias	8	4.9	6	4.9
Baleares	6	3.7	6	4.9
Canarias	6	3.7	4	3.3
Cantabria	2	1.2	2	1.6
Castilla La Macha	4	2.5	3	2.4
Castilla y León	3	1.8	1	0.8
Cataluña	22	13.5	18	14.6
Cdad. Valenciana	18	11	11	8.9
Extremadura	4	2.5	4	3.3
Galicia	9	5.5	5	4.1

[1] These include: (1) R&D and innovation public programs and plans, both at the national and regional level; (2) institutional web directories of R&D organizations, both at the national and regional level and (3) the webpages of the research centres with on-going R&D collaborative agreements.

Madrid	15	9.2	10	8.1
Murcia	2	1.2	2	1.6
Navarra	4	2.5	2	1.6
País Vasco	21	12.9	17	13.8
Rioja (La)	3	1.8	3	2,4
Total	**163**	**100**	**123**	**100**

Table 1: Geographical distribution of the population and sample of CRCs in Spain

3.2 Variables

We use three independent variables CRC's funding sources: (1) *proportion of funds from public competitive calls* and (2) *proportion of funds from contracts and services to firms* and (3) *Shannon Diversity Index* of funding sources. The two fist variables are the most important sources of funding in relative terms, representing the 63% of funds of CRCs.[2] The Shannon Index[3] considers all funding sources and aims to analyse the diversity in the structure of the funding portfolio of each CRCs. If the majority of funds come from one source, and other sources are very rare, the index approaches to 0.

The central variables in our analysis aim to take into account the degree of intersectoral collaboration of CRCs. These are measured by the degree of involvement that each sectoral partner ─ Universities and research centres, government and firms ─ has in the CRC at three different organisational levels: setting the CRCs objectives; R&D execution and management and evaluation. We consider CRC responses to a set of nine 5-scale questions[4] ranging from "Not Important" to "Very important" on these issues. We obtain our final proxies for degree of intersectoral collaboration through a principal component analysis (PCA),[5] resulting in three variables with propensity scores for the three components:

› *"Market Oriented"* ─Component 1─ is mainly characterised by:
    - A high participation of the firms and Research Centres on direct execution of R&D
    - Firms are also important in the definition of CRC's strategic plans
    - Firms are also involved in the control and supervision of the CRC.

› *"Government Oriented"* ─ Component 2 ─ is mainly characterised by:
    - Government is highly involved in the control and supervision of the CRC

[2] Funding sources are distributed as follows: "direct public funds" represents the 32% of the funds of CRCs; "Contracts and services to firms" follow with a 31%; "direct public funds" account for a 24.1%; "Membership fees", "public contracts and services" and "Intellectual Property Rights" are minor funding sources with 6.3%, 5.1% and 0.3% respectively. "Other" funding sources account for 1.2% of the funds.

[3] The Shannon Index was originally an indicator of biodiversity in ecological systems, but now is frequently used to measure diversity in categorical data. The index is calculated by summing the products of each funding sources' (or species) *I* share *p* with the natural logarithm of the same share and multiplying by -1. ($S= -\Sigma p_i \ln p_i$)

[4] The questionnaire included a set of 12 questions. To avoid a problem of independence we have excluded three questions that covered funding issues.

[5] Principal component is done considering six of these variables. Variables like the one that captures degree of involvement of government in R&D execution were not taken into account as results showed that the degree of involvement of this agent in this activity was not important.

- o Government is highly involved in the definition of CRC's strategic plans
- o Firms are not involved in the direct execution of R&D

› *"Academic Oriented"* ─ Component 3─ is mainly characterised by:

- o Low involvement of firms in definition of CRC's strategic plans
- o High involvement of Research organisation in the direct execution of R&D
- o Government have a role in the control and supervision of the CRC.

Other important explanatory variables are *R&D Activities*, *Sector*, *legal form*, *size*, *year* and *regional R&D intensity*. Four different dummy variables consider the importance of diverse *R&D Activities* of CRCs ─ R&D Basic, R&D Applied, Technological development and Technological Services. These take the value of 1 when the CRC considers the activity as "very important" (the highest level of a 5-scale question). These four variables are included after checking that they are not highly correlated. *Sector* of economic activity is a categorical variable with three categories ─ Primary, Secondary and Tertiary. *Legal form* is a dummy variable that takes the value of 1 if the CRC is a Foundation and 0 otherwise. *Size* is proxied by the total number of personnel of the centre. *Year of foundation* is a dummy variable that takes the value of 1 if the CRC was founded in 2008 or afterwards. *Region* considers the R&D Intensity ─ Gross Expenditures on Research and Development (GERD) as a percentage of the Gross Domestic Product (GDP) ─ of the region in which the CRC is located for the year 2011 (last year available INE).

3.3 The model

To explain our dependent variables ─ (1) proportion of public competitive funds, (2) proportion of funds coming from contract and services to firms and (3) Shannon diversity Index ─we use a two-limits Tobit model:

$$y_i = \begin{cases} y_i^* & \text{if } y_L < y_i^* < y_U \\ y_L & \text{if } y_i^* \leq y_L \\ y_U & \text{if } y_i^* \geq y_U. \end{cases}$$

$$y_i^* = \beta x_i + u_i.$$

where y_i^* is a latent variable censored from above and below at the same time and x_i a set of explanatory variables. YL is always ≥ 0. Yu ≤ 1 for dependent variables (1) and (2) and Yu≤ 1.6 for our last dependent variable (3).

4 Results and discussion

In this section we present the results of the descriptive and econometric analysis based on the two-limit Tobit model

4.1 Descriptive statistics

Table 2 presents the summary of statistics. Our average CRC gets the 32% of their funds from public competitive calls, a 31% from contracts and services to firms. These are the main source of funds for CRCs. The average Shannon Diversity Index of funding sources is 0.87. Most part of CRCs recognises that Applied R&D activities are "very important". Technological development and Technological services are also important activities with, respectively, a 44% of CRCs recognising that these activities as "very important". Basic R&D Activities are less essential for CRCs with a 22% of them affirming that they are "very important". Although the different variables on R&D Activities are not highly correlated, the importance of R&D Basic activities is negatively correlated to the importance of technological development and technological services. This is also the case for the degree of importance of R&D applied and technological services activities. This indicates that less applied research activities are difficult to combine with more technological oriented activities. Most part of CRCs is involved in the secondary sector of the economy with a 65% of centres reporting this sector as their main sector of economic performance. A 25% of CRCs are mainly involved in the tertiary sector of the economy, whereas a 10% do so in the primary sector. A 52% of CRCs are foundations. The average CRC has 136 workers. A 18% of the CRCs were founded after 2008. The average CRC is located in a region with a R&D Intensity of 1.28 in 2011, close to the Spanish average of 1.33.

Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min**	**Max**
Funds from public competitive calls	107	0.32	0.23	0	0.99
Funds from contracts and services to firms	107	0.31	0.26	0	0.95
Shannon Diversity Index of funding sources	107	0.87	0.33	0	1.50
R&D Activity					
R&D Basic	104	0.22	0.42	0	1
R&D Applied	104	0.53	0.50	0	1
Technological development	105	0.44	0.50	0	1
Technological Services	105	0.44	0.50	0	1
Sectors					
Primary	103	0.10	0.30	0	1
Secondary	103	0.65	0.48	0	1
Tertiary	103	0.25	0.44	0	1
Legal Form (Foundation)	123	0.52	0.50	0	1
Size (personnel)	79	136.34	337.80	1	2628

Year Foundation	123	0.18	0.38	0	1
Region (R&D Intensity)	123	1.28	0.51	0.36	2.07

Table 2: Summary statistics

4.2 Multivariate analysis

Table 3 presents results of the econometric analysis from the two-limit Tobit regression (Long, 1997).[6] We report seven sets of results from the analysis of three dependent variables: (1) Proportion of Funds from public competitive calls, (2) Proportion of funds from contracts and services to firms and (3) Shannon's Diversity Index of funding sources. First three columns show results of different specifications of a regression of the proportion of funds from public competitive calls on our main independent variables ─ type of CRC defined by the degree of involvement of different sectoral partners ─ (i), adding R&D activity and economic sector controls (ii) and other institutional and regional controls (iii). We present similar specifications for the analysis of the proportion of funds coming from contracts and services to firms (iv-vi). Finally, the last column (vii) provides results of the regression of the Shannon's Diversity Index of funding sources on our main independent variables controlling for the rest of variables.

The results of the first specification (i) show that the coefficient of "market oriented" CRCs is negative and significant. The effect is on the uncensored latent variable, not on the observed outcome (McDonald and Moffit, 1980). The coefficients for "academic oriented" and "government oriented" CRCs are positive but not significant. This indicates that CRCs with "market oriented" characteristics rely less on funds coming from competitive calls.

Specification (ii) confirms the negative effect of "market oriented" CRCs on the proportion of funds coming from competitive public calls when including controls for R&D activity and economic sector activity. The coefficient for this type of CRC increases significance compared to previous specification. Regarding R&D activities, the coefficients for basic and technological services activities are positive and significant. This indicates that CRCs for which basic and technological services are very important have a higher proportion of funds coming from public competitive calls. This could indicate that there is not a crowding-out effect of basic and technological services activities or that CRCs are specialised in one of this two activities. The coefficients for tertiary sector are negative and highly significant (1%), pointing that CRCs that concentrate their activities in the tertiary sector of the economy have a lower proportion of funds coming from public competitive calls when compared to CRCs whose main activity are in the secondary sector of the economy. This shows that CRCs with market oriented characteristics whose main activities are in the tertiary sector of the economy do not tend to have

[6] We have also considered a general linear model (Papke and Wooldridge, 1996) with a logit link and the binomial family to have also predicted values between zero and one. We include the robust option to obtain robust standard errors. However, as values of 0 and 1 or close to these figures are relevant answers, we have opted for a two-limit Tobit model in order to take into account this. Two models lead to similar results.

a high proportion of funds coming from public competitive funds whereas CRCs for which basic and technological R&D activities are very important do rely more importantly in this source of funds.

Specification (iii) confirms the negative effect of “market oriented” characteristics on the proportion of funds coming from competitive calls when including all the controls. However, the coefficients for basic R&D activity and tertiary sector are not significant when including controls for the legal form, size, year of foundation of the CRCs and R&D Intensity of the region in which the CRC is located. The coefficients for “year of foundation” and “R&D intensity” are positive and significant at 10% level of significance. This indicates that CRCs that were funded after 2008 were more able to collect a high proportion of funds from competitive public calls. It appears that CRCs located in regions with high R&D intensity rely more heavily on public competitive calls. Our first hypothesis is not confirmed as coefficients for “academic oriented” are not significant, but we see that the CRC characteristics affect the ability to acquire this source of funds, negatively for “market oriented” characteristics. In summary, CRCs with “market oriented” characteristics rely less in funds coming from public competitive calls whereas young CRCs that provide technological services, located in regions with high R&D intensity do rely more on this source of funds.

Considering the three specifications of the proportion of funds coming from contracts and services to firms, we can see in the first specification (iv) that the effect of “academic oriented” is negative and significant at 5% level. This indicates that CRCs with academic oriented characteristics rely less on funds coming from contracts and services to firms. The coefficients for “market oriented” CRCs are positive whereas the coefficient for “government oriented” is negative, but both coefficients are not significant. The coefficient for “academic oriented” CRCs is also negative and significant when including controls for R&D Activity and economic sector (v). However, this coefficient becomes non-significant in the last specification (vi) when all the controls are included. The coefficient for “basic R&D activity” is negative and significant across specifications. This points that CRCs for which basic R&D activities are very important tend to rely less on funds coming from contracts and services to firms. The coefficient of “year of foundation” is negative and significant, indicating that CRCs founded after 2008 proportionally rely less on funds coming from contracts and services to firms. This could also indicate that CRCs founded during the crisis had more difficulties for getting funds from contracts and services to firms. It appears that “academic oriented” CRCs rely in a lower proportion on contracts and services to firms, but other factors, such as, basic R&D activities and year of foundation are more determinant than the type of CRC when explaining the proportion of funds coming from contracts and services to firms.

The results of the regression on the Shannon’s Diversity Index (vii) show that the coefficient for “academic oriented” is positive and significant, indicating that CRCs with academic oriented characteristics have a more diversified source of funds. This confirms our third hypothesis that CRC characteristics have an effect on the degree of diversity of funding sources. The coefficient for “market oriented” is also positive but not significant. The coefficient for “government oriented” is negative but also not significant. Then, we cannot say that CRCs with these characteristics affect to the diversity of funding portfolio. Considering R&D activities, the coefficients for “basic” and “technological development” are negative and significant. This indicates that CRCs for which these activities are very important have a less diversified funding portfolio. This could indicate that “less applied” research and technology activities have more difficulties to acquire funds from different sources. It appears that these types of activities are more dependent of a specific source of funds. This could be due the intrinsic characteristics of the R&D activity or due to the lack of “abilities” of the personnel of the CRCs specialised in this R&D activities to acquire funds from different sources. The coefficient of “tertiary sector” is negative and significant indicating that CRCs whose main economic activity is in the tertiary sector have a less diversified funding portfolio compared to CRCs operating in the secondary sector of the economy. The coefficients for legal form, size, year of foundation and region are not significant. In summary, the orientation of the CRCs has an effect on the diversity of the funding portfolio and that “less applied” research and technologies and tertiary activities reduce the diversity of the funding portfolio.

The p-values of likelihood ratio chi-square tell us that our model fits significantly better than an empty model. Sigmas values are lower than standard deviation of the first (0.234), second (0.310) and third (0.328) dependent variable (for 106 sample). The predicted values share about 45% and 50% of their variance with first and third dependent variable.

		Proportion Funds from public competitive calls			Proportion Funds from “contracts and services to firms			Shannon's Diversity Index
		(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)
Type CIC (mix model)								
	Market Oriented	-0.0319*	-0.0607***	-0.0728***	0.00365	0.0194	0.00833	0.0409
		(0.017)	(0.018)	(0.020)	(0.020)	(0.021)	(0.025)	(0.027)
	Government Oriented	0.00143	-0.00363	-0.01	-0.0176	-0.0181	0.0158	-0.0416
		(0.023)	(0.021)	(0.022)	(0.027)	(0.025)	(0.027)	(0.030)
	Academic Oriented	0.0402	0.0356	0.02	-0.0770**	-0.0566*	-0.0135	0.0930**
		(0.025)	(0.025)	(0.030)	(0.029)	(0.030)	(0.038)	(0.041)
R&D Activity								
	RD_Basic5		0.145*	-0.02		-0.261**	-0.254**	-0.444***
			(0.081)	(0.091)		(0.098)	(0.114)	(0.124)
	RD_Applied5		-0.0485	0.01		-0.0203	-0.0827	-0.0248
			(0.055)	(0.062)		(0.066)	(0.078)	(0.085)
	TechDevelopment5		0.045	0.10		0.0917	-0.018	-0.198**
			(0.053)	(0.065)		(0.065)	(0.081)	(0.088)
	TechServices5		0.171***	0.150**		-0.0367	0.0111	0.135
			(0.060)	(0.069)		(0.073)	(0.087)	(0.095)
Sector	(Secondary)							
	Primary		0.137	0.08		-0.169	-0.107	-0.0493
			(0.090)	(0.091)		(0.109)	(0.114)	(0.125)
	Tertiary		-0.167***	-0.10		-0.0501	-0.121	-0.357***
			(0.061)	(0.077)		(0.073)	(0.096)	(0.105)
Legal form								
	Foundation			-0.03			0.0533	0.0543
				(0.056)			(0.070)	(0.077)
Size								
	Total Personnel			0.00			0.000734	-0.000418
				(0.000)			(0.000)	(0.000)
Year foundation								
	2008			0.152*			-0.193*	0.102
				(0.080)			(0.100)	(0.109)
Region								
	R&D intensity			0.139*			-0.0624	0.134
				(0.076)			(0.095)	(0.104)
Constant		0.297***	0.224***	0.06	0.357***	0.415***	0.541***	0.887***
		(0.026)	(0.053)	(0.129)	(0.030)	(0.064)	(0.162)	(0.177)
Sigma		0.197***	0.173***	0.152***	0.230***	0.209***	0.190***	0.208***
		(0.018)	(0.017)	(0.017)	(0.021)	(0.020)	(0.021)	(0.023)
N		58	55	41	58	55	41	41
likelihood ratio chi-square		5.65	22.1***	24.43**	6.97*	17.37**	22.03**	28.85***

5 Conclusions and recommendations

This paper analysed public-private collaborative agreements in Spain. Due to their public-private nature, Cooperative Research Centres are becoming relevant actors in the R&D research systems. We addressed the analysis of the funding structure of CRCs considering the degree of intersectoral collaboration and controlling for other aspects. We characterised CRCs ─ “market-oriented”, “academic-oriented” and a “government oriented”─ according to the degree of involvement of each sectoral actor in diverse organisational aspects ─ setting their objectives, executing the R&D, and establishing the managerial processes and evaluation practices. We focused on the effect of these characteristics of CRCs on the public ─ public competitive funds ─ and private ─ contracts and services to firms ─ nature of its funding sources, as well as, on the diversity of all funding sources.

The analysis of the proportion of competitive public funds showed that CRCs with “market oriented” characteristics rely less on this funding source. This funding source was also less common for CRCs whose main activities are in the tertiary sector. However, young CRCs that provide technological services, located in regions with high R&D intensity relied more on this source of funds.

The analysis of the proportion of funds coming from contracts and services to firms provided some evidence that indicates that CRCs with “academic oriented” characteristics rely less on this funding source. However, other factors, such as, basic R&D activities and year of foundation were more determinant than the type of CRC when explaining the proportion of funds coming from contracts and services. CRCs for which basic R&D activities are very important rely less on this funding. This was also the case of young CRCs that started their activity during the economic crisis.

Regarding the diversity of sources of funding of CRCs, we found that the orientation of CRCs has an effect on the diversity of the funding portfolio, being CRCs with “academic oriented” characteristics the ones with a higher diversity of funding sources. The increasing proportion of research funds allocated through competitive funds appears to have encouraged academic researchers and managers making them more able to acquire funds from different funding sources. CRCs focused on “less applied” research and technology activities, as well as the ones that focus on the tertiary sector of the economy, showed a lower diversity of their funding portfolio.

These results showed that the degree of intersectoral collaboration of sectoral actors in the CRCs’ organisation have an effect of the funding structure of CRC. Particularly, we found that CRCs with “market oriented” characteristics rely less on public competitive funds and CRCs with “academic oriented” characteristics have a more diversified funding portfolio. This indicates that the involvement of each sectoral partner in the CRC affect their ability to acquire funds and their behaviour.

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Knowledge Management And Applied Tools In Small Businesses: Case Study Of A Spin-Off

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Abstract
Knowledge is a mix of framed experiences, contextual information and expert insights, existing within people. In organisations, it becomes embedded in documents and also in organisational routines and processes. The concept of knowledge management (KM) introduces the processes of making knowledge available and connecting people to people and people to information. Certain techniques and practices, named KM tools, can be used to acquire, share and store intellectual assets and promote the interaction among academic institutions, organisations and their members.

This paper aims to map KM tools, relate theory to practice and identify the contributions of knowledge management to small businesses and their networks. A case study of a spin-off and technology transfer centre of a research institute is undertaken to explore the exchange of knowledge among its members. In order to analyse group interaction and stress relevant factors in relation to KM, the methodology is based on a quantitative and a qualitative approach, making use of a questionnaire and semi-structured interviews. The data is compared to the findings of a literature review and the results are structured into the three stages of knowledge: knowledge creation, sharing and capturing.

The results appoint the use of KM tools and a considerable level of sharing information in the informal environment. Knowledge techniques are implemented by employees, but sometimes they are not structured into organisational processes. Outside the organisation; conferences, cooperation projects and consortiums provide groundwork to convey explicit knowledge in documents, articles and data. Besides regional business networks, cooperation across institutions on technical and market research and a shared knowledge base are suggested as strategies to improve the success of the business.

In conclusion, the implementation of KM tools can be applied as a competitive strategy to eliciting information and achieving results through working partnerships. Furthermore, these techniques contribute to develop and retain excellent experts and their background knowledge at institutions.

Keywords
Knowledge management, knowledge tools, spin-off.

1 Introduction

Society has been denominated as Knowledge Society by scientists since the last decade. The main goal of this concept is storing and transmitting large quantities of information.

Therefore, knowledge is the most important product in Knowledge Societies rather than labour or capital.

According to the literature (Angeloni, 2003; Sabbag, 2007; Nonaka & Takeuchi, 2008), Knowledge Society addresses the importance of intangible assets, i.e. knowledge. Due to the rapid acceleration in economic and technological changes, the management of knowledge is emphasised as the most important product in Knowledge Societies.

The concept of knowledge management has been introduced as an important technique to cope strategically with continuous changes, and with the search for high technology and for highly qualified professionals. The main goal of this concept is storing and transmitting large quantities of information.

Sabbag (2007) argues consequently that it has been impossible to think of knowledge management just as a means of preserving the existing knowledge. Knowledge management just makes sense if it is managed on behalf of the creation and application of new knowledge. Ichijo & Nonaka (2007) reinforce the argument by stating that the emphasis on changes in the global environment has put knowledge management at the heart of what organisations need to do in order to improve their performance and competitiveness.

To promote the knowledge within the organisation and to make use of it, managers need to create an appropriate environment where employees can apply their abilities and creativity to produce new and innovative ideas. Knowledge management tools (KM tools) can be used to promote a collaborative working environment. Such tools and techniques allow the identification of knowledge and enable its application to business processes and joint projects.

In this context, the article aims to map KM tools, relate theory to practice and identify the contributions of knowledge management to small businesses and their improvement. The article is divided into two main chapters – the theoretical background and the case study. The theoretical chapter provides an overview of knowledge management and a description of KM tools. Part two focuses on the case study. There is an introductory description about the spin-off, followed by the description of the results and an analysis relating theory to practice.

2 Background

Knowledge includes beliefs and commitments, facts and experiences, being related to human actions. Davenport & Prusak (1998) and Nonaka & Takeuchi (2004) agree that knowledge exists within people; it is part of human complexity and consequently, unpredictable. Other researchers describe knowledge as a set of theoretical or practical understanding; they refer to knowledge as intangible assets (Sweiby, 1996), competences and learning (Fleury, 2001), intellectual assets, creativity (Alencar & Fleith, 2002) and organisational knowledge (Nonaka & Von Krogh, 2009).

Davenport & Prusak (1998) and Nonaka & Takeuchi (2008) define knowledge as information, which is in people's brains and difficult to extract. "Knowledge is a fluid mix of framed experiences, values, contextual information and expert insights that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers" (Davenport & Prusak, 1998:5).

Knowledge is also based on a learning cycle, which includes data and quantified information. Data is a set of objective facts describing something, though the facts are not interpreted. Information is data compared with other data and its interpretation with a purpose. After thinking of data, it is transformed into knowledge by adding values. Those values mean the analysis of data according to the context, its classification into components, its mathematical analysis and the correction of error (Davenport & Prusak, 1998).

Knowledge management has three main activities: creating, sharing and storing knowledge. Knowledge creation is encouraged by the organisational culture and interaction among people. After creating new knowledge, it must be shared between team members and also between businesses and functions (Ichijo & Nonaka, 2007). To conclude the process, knowledge must be stored within the organisation to transform new ideas into explicit knowledge.

2.1 Types of knowledge: explicit and tacit

According to Nonaka & Takeuchi (2004) knowledge can be classified into two types: explicit and tacit. Tacit knowledge means 'internal' personal knowledge, acquired through practice. It is difficult to quantify, because it is subjective and based on experiences and cognitive elements or mental models (Nonaka & Takeuchi, 2004). Explicit knowledge is the knowledge that has to be 'externalised' in some suitable form. It is objective and rational knowledge that can be expressed in words and sentences (APO, 2010).

Nonaka & Takeuchi (2004) also introduce the spiral of knowledge, a model that describes the flow of knowledge creation and the ways to convert intellectual asset into explicit or tacit knowledge (Table 1).

	Tacit	Explicit
Tacit	*Socialisation* Sharing experiences Observing Brainstorming	*Externalisation* Writing it down Creating analogies Modelling
Explicit	*Internalisation* Access to codified knowledge Training	*Combination* Sorting, adding Methodology creation Best practices

Table 1: Spiral of knowledge (Source: adapted from Nonaka & Takeuchi (2004))

The model is a clockwise spiral, viewed as a continuous learning process. The spiral is divided into four phases and emphasises the interaction among individuals and knowledge transfer.

Socialisation means the process of exchanging tacit knowledge. It involves observation and direct interaction with customers and suppliers and people inside the organisation (Nonaka & Takeuchi, 2004).

Externalisation is the process of making tacit knowledge explicit. Dialogue and face-to-face communication help the articulation of tacit knowledge in order to its translation into a readily understandable form. There is a simultaneous exchange of ideas (Nonaka & Takeuchi, 2004).

Combination is the dissemination of different forms of explicit knowledge, which can be conveyed in media as documents, e-mails and databases.

The last phase is internalisation, the process whereby people understand and absorb explicit knowledge, and broaden consequently their tacit knowledge.

2.2 Knowledge management tools

The four phases of conversion can be stimulated through specific tools, which are classified by Angeloni (2003) and Servin (2005) into three components: people, technology and process.

The component "People" relates to organisational culture, including a comfortable working environment to share ideas and the regular contact among employees. "Technological tools" are software and platforms used as enablers of knowledge management to connect people to technology and people to people.

“Processes” involve decision-making and a series of actions. In order to improve knowledge sharing, organisations need to make changes to the ways their internal processes are structured; otherwise processes can be barriers to knowledge (Servin, 2005).

An organisation’s primary focus should be on developing a knowledge-cooperative environment and knowledge-friendly behaviour among its employees, which have to be supported by appropriated processes, and which may be enabled through technological tools (Servin, 2005).

The following paragraphs present a short selection of KM tools and their definitions.

Connecting people to people:

The tools and techniques described below emphasise communication among people as an effective way to learn other’s experiences.

(1) **Peer Assistance** is a technique used by a project team to get assistance from peers and from subject matter experts with regard to a significant issue the team is facing (APO, 2010).

(2) **Community of Practice (CoP)** means a network of people who share a common interest in a specific area of knowledge and are willing to work and learn together over a period of time (Servin, 2005).

(3) **Knowledge Clusters** are agglomerations of organisations that are production-oriented. Their production is primarily directed to knowledge as output or input. Examples are research institutions, government research agencies and knowledge-intensive firms (MPRA, 2008).

(4) **After Action Review** is a tool to evaluate and capture lessons learned (IDEA, 2008). Usually, it is structured as an informal discussion with the main team members of the project (APO, 2010).

Connecting people to processes:

The tools to connect people to processes describe activities about the way of doing things in the organisation to achieve specific organisational purposes.

(5) **Social Network and design (SNA)** mean the activity of mapping relationships between people and identifying knowledge flows.

(6) **Learning and Idea Capture** is a key aspect of knowledge management at the personal and team level. Learning and idea capture addresses ways to communicate and obtain ideas (APO, 2010). For example, through blogs, personal notes, chat rooms and publications.

Connecting people to technologies:

In the context of knowledge management, technological tools support communication among people and facilitate knowledge storing.

(7) **Social media and social networking** are online systems that support social networking. The core services of social media usually include finding people who have similar interests or needs, and sharing content (APO, 2010).

(8) **Groupware** is collaborative software to sharing information and coordinate activities via a computer network. Most groupware packages include a shared database, group schedulers, calendars and/or e-mail systems. Through the combination of these sets, team members can work together on a single document, maintain records and schedule meetings (Servin, 2005).

(9) **Collaborative Virtual Workspaces** are software packages that involve a combination of document sharing, collaborative editing and audio/video conferencing (APO, 2010). The tool enables people to work together, independently of where they are physically located.

(10) **Knowledge Base** is an information repository that creates new knowledge for a topic, expands the knowledge by discussions, edits the expanded knowledge into new knowledge and maintains the history of revisions (APO, 2010).

Blog, chat, e-mail and video conferences are also KM tools, which facilitate knowledge sharing through web sources.

3 Methodology

This paper aims to present a specific case, analyse the application and the problems related to KM tools and give practical recommendations for them.

The analytical instrument - case study - was chosen to understand the use of knowledge management in practical situation by analysing group interaction and emphasising factors in relation to KM. This approach allows an in-depth analysis of the processes investigated here.

The theoretical insights presented in chapter II guide the research design (see below), as well as the structure of the discussion. The research involves quantitative and qualitative approaches. A questionnaire with multiple-choice answers was distributed among team members, and semi-structured interviews were conducted with employees to collect descriptive information.

4 Case Study

The focus of the case study is the spin-off neoplas GmbH from the Leibniz Institute for Plasma Science and Technology (INP Greifswald), both institutions situated in Greifswald.

4.1 The Leibniz Association and the Institute for Plasma Science and Technology

The *Wissenschaftsgemeinschaft* Gottfried Wilhelm Leibniz or Leibniz Association is based on a joint funding and constant evaluation of research institutes by the federal government and its states governments.

Currently, the Association has 86 member institutes, which are focused on a variety of research areas and cooperate with universities and other research organisations. Their partnerships and initiatives promote clusters of excellence, graduate schools and concepts for the future. In addition, at least 123 innovative businesses have spun off from 38 Leibniz institutions since 1990 (Leibniz, 2012).

The city of Greifswald (Mecklenburg-Western Pomerania) is seen by many scientists as a national reference in plasma technology and hosts an important Leibniz institute and its three innovative businesses (spin-offs), besides other plasma technology organisations (Plasma Umwelt, 2012).

The INP Greifswald was founded in 1992. Its scientific research is divided into three focus areas: materials and surfaces, biology and medicine, and environment and energy. The INP Greifswald aims to carry out application-oriented basic research and optimise the development of established plasma-assisted procedures and plasma products (INP, 2012). Currently, the institute has 50 laboratories, 181 employees and an annual budget of approximately 14 million € (INP, 2012).

The institute formed three new institutions: neoplas GmbH (2005), neoplas control GmbH (2006) and neoplas tools GmbH (2009). For legal reasons, the INP Greifswald is concentrated on applied-oriented & basic research and cannot develop market-ready products. This is reflected in the institute´s slogan “From the idea to the prototype“. In order to extend the value chain without compromising its principles, the INP Greifswald founded the neoplas GmbH as a transfer centre.

Neoplas GmbH develops and builds prototypes, even small series, and offers management and marketing support for the INP Greifswald, its spin-offs and other clients. That facilitates the next level of the value chain “From prototype to product”. Once a product is developed and designed, it might either be licensed out or brought to the market. The process “From product to market” is managed by another spin-off. This way was chosen in the case of neoplas control and neoplas tools.

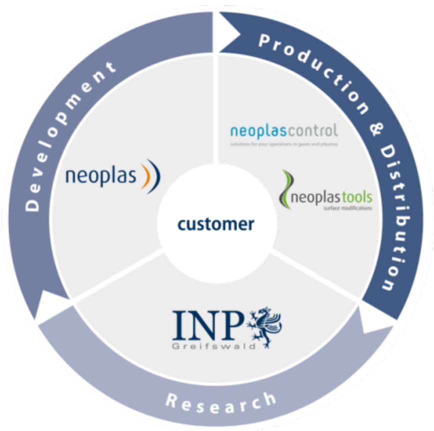

Figure 1: From the idea to the market - technology transfer among the INP Greifswald and its spin-offs (Source: neoplas GmbH (2012))

4.2 The spin-off case study

The spin-off neoplas is a legal entity with limited liability, a GmbH. The GmbH is a common legal form in Germany and mostly chosen from small- and medium-sized businesses (Foerster+Rutow, 2007).

Founded as a spin-off, neoplas GmbH operates as a private and independent company. It is responsible for its management, partnerships, commercial activities and production. Neoplas GmbH has 14 full-time and 4 part-time employees, but also conducts projects together with researchers and scientists from the INP Greifswald, who work for the spin-off on a temporary employment contract.

The spin-off is divided into three main organisational groups: Technology Management, Technology Marketing and Technology Development.

The management team is concerned with research for innovation, pre-project coordination, patent and contract management, entrepreneurship and coaching, as well as the identification of funding programs. The team supports on-going research by enabling scientific and economic impulses.

Marketing activities include advertising and marketing technology. The experts in design are focused on the visualisation of research ideas and results by doing graphic and web-design, project reports and organising congresses and workshops.

The technical team develops prototypes and boosts small series. Researchers and engineers work on plasma process development (decontamination, coating etc.) and surface modification (activation, enzyme mobilisation etc). The technology development group designs, develops and builds individual complex plasma systems for low or atmospheric pressure (neoplas GmbH, 2012).

Under the three aforementioned competences, neoplas GmbH defines the company's mission as filling the gap from prototypes to ready-to-use products, i.e. linking science and technology with business and offering services from research ideas to product launch.

In addition, neoplas GmbH carries out joint projects with the INP Greifswald and the other two spin-offs within the field of technology development. The following figure illustrates this working relationship.

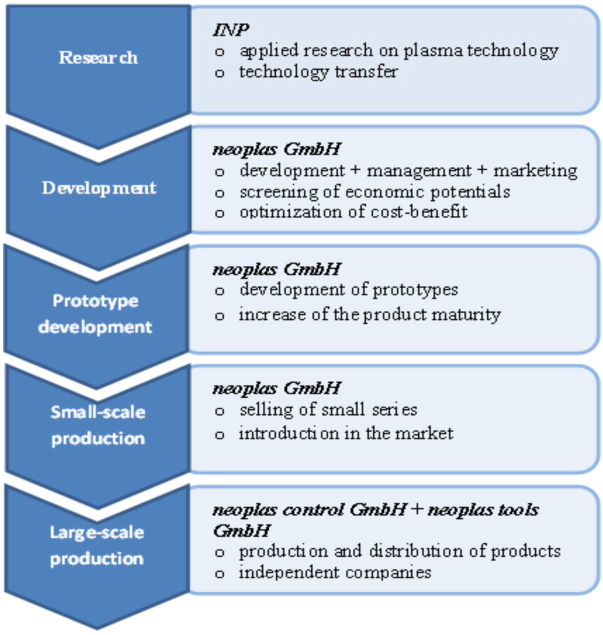

Figure 2: Intra-organisational workflow (Source: adapted from neoplas GmbH (2012))

The scientists have research ideas, which are transformed into practice by the technicians and engineers (INP Greifswald). The prototype is evaluated in accordance to the product needs and the financial and market viability by the product designers (neoplas GmbH). Afterwards the product goes back for evaluation and optimization to the research institute. Neoplas tools GmbH and neoplas control GmbH are responsible for the distribution in the market.

Neoplas GmbH is also connected to other technology transfer organisations through a consortium. Led by the spin-off, the Research2Market Consortium aims to provide consulting services to scientists and small companies. Research2Market brings together over 200 employees and can count on the work from more than 1,000 external experts from different industry sectors (neoplas GmbH, 2012).

Considering neoplas GmbH being an enabler of knowledge transfer and a bridging institution between research and market, one can assume that knowledge management is a major strength of the company. Knowledge sharing and communication inside and between the participating units and within the organisation have to flow smoothly, as this can be seen as a precondition for a well functioning transfer of knowledge and technologies to the outside (from research to market).

Therefore the spin-off is a potential case study to explore knowledge management within the organisation and knowledge transfer with its partners.

4.3 Data analysis and discussion

According to Nonaka & Takeuchi (2004) and Hostler (2005), the knowledge management process is based on three main phases: knowledge creation, sharing and storing. By using this concept, the analysis of gathered data was carried out to identify structuring factors in each stage of knowledge.

An online questionnaire with multiple-choice questions was distributed and filled out by 82% of the members of the organisation, including designers, engineers, physicists, managers, secretaries and technicians. All participants could add comments on questions. The results, including answers and comments, are illustrated with tables and graphics.

Knowledge creation is the process of amplifying and making knowledge created by individuals available, as well as connecting it to the organisation (Nonaka & Von Krogh, 2009).

Two questions concerning the creation of knowledge were framed. The first one was about trainings, if the company offers on-the-job or off-the-job trainings for the team and how often they occur. The question aimed to find out if practical courses are a way to stimulate knowledge creation in the company.

66.6% of the respondents did participate in training courses during the past two years. According to the answers, both neoplas GmbH and the INP Greifswald financed 66.6% of the training courses. Other 44.4% were non-costs events and no course was financed from the employees.

33.3% of the respondents, who did not participate in training courses, gave the following reasons for their responses: there was no training budget in the current project, and her/his job position as an advisor does not involve direct work on projects.

The next question was asked to identify whether there are opportunities within the organisation to express ideas. All respondents said that opportunities exist, but not regularly. 44.4% of the respondents believe that there is a positive encouragement (always and very often) to communicate ideas and 33.3% that this happens occasionally. 22.2% of the respondents think that such opportunities are rare.

Three questions were framed in order to identify ways to share knowledge. Knowledge sharing addresses formal or informal ways to share tacit and explicit knowledge.

The first question was about which tools are daily used to undertake work activities.

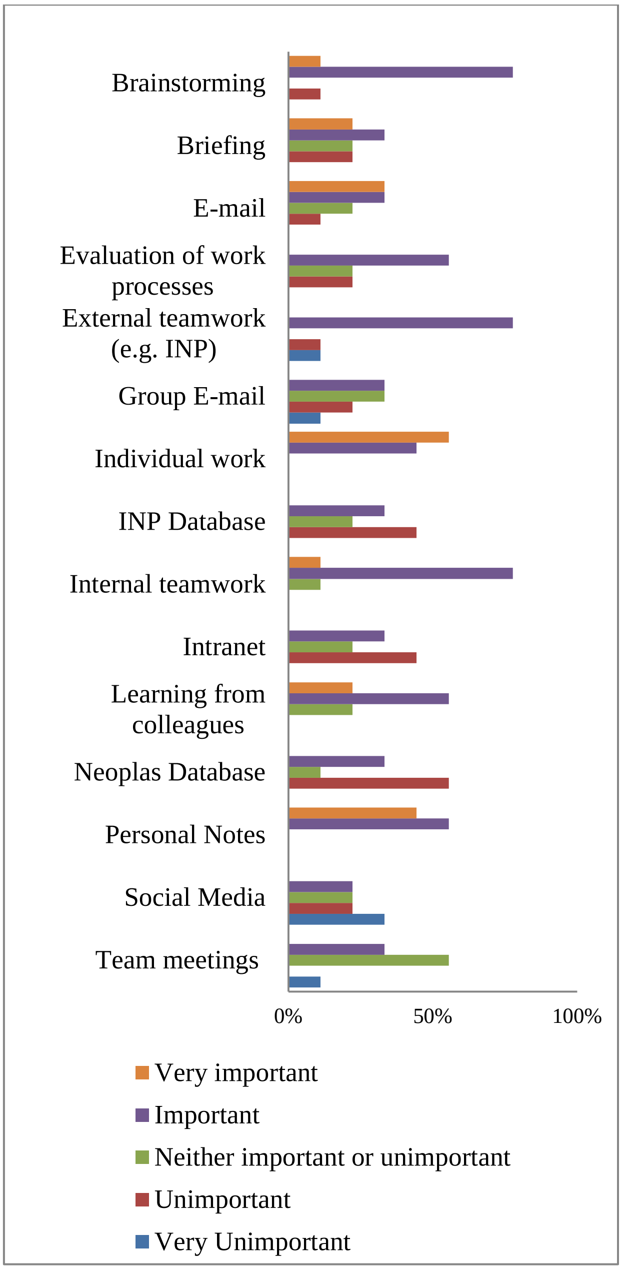

Figure 3: Knowledge management tools

The most important results (very important and important) were personal notes and individual work. Although personal notes are important, usually they are private messages or reminders, which means that information is not conveyed in explicit knowledge. Individual work is also considered as a very important / important instrument in neoplas GmbH (100%).

Learning from colleagues and internal teamwork were rated highly, except by one respondent. External teamwork was in general considered as an important way to share ideas and undertake activities.

Interviews confirmed that team meetings and mainly e-mails are very useful instruments to share information. However, 55.6% of respondents said that team meetings do not make a difference to their work activities (neither important nor unimportant).

Although the responses are dispersed, e-mail is an essential tool to neoplas GmbH to exchange daily organisational information. Briefing, brainstorming and evaluation of processes are not just KM tools, but also part of project management. Brainstorming is the most relevant of them (77.8%), and reflects the importance of knowledge sharing in speech.

Considering the aforementioned data, the tools selected as important or very important require direct contact among employees. This fact shows that the exchange of information within organisations is more related to speech than writing – reports, documents and databases.

There are databases from the INP Greifswald and neoplas GmbH, however they are considered by the majority as unimportant or indifferent to their activities. The tool neoplas database was chosen as unimportant by 55.6% of the respondents. That can be a problem due to the fact that researching and producing project results are activities of the company, but their outcomes are not stored in databases.

The second question aimed to find out if there is more individual or collaborative work. Employees from the research institute and neoplas GmbH carry out joint projects, but they do not work together frequently. Employees from the spin-off spend about 25% of their time on group working with INP´s employees. Although this question was not completely answered by all respondents, the most of them work alone (50% or 75% of their workload).

The third question was about knowledge transfer. It addressed the sharing of knowledge between the INP Greifswald and neoplas GmbH.

Knowledge transfer tools	**Used**	**Not used**
Informal environment (Example: coffee breaks, smoking room)	88.9%	11.1%
Carrying out projects	88.9%	11.1%
INP Database	11.1%	88.9%
Neoplas Database	0.0%	100.0%
Talk on the phone	100.0%	0.0%
Direct contact	100.0%	0.0%
E-mail and Intranet	88.9%	11.1%
Other	11.1%	88.9%

Table 2: Knowledge transfer between neoplas GmbH and the INP Greifswald

Table 2 shows the non-use of databases once again. The written information is obtained from intranet and e-mail (88.9%), an effective way to share and store information in the company. The options “informal environment”, “talk on the phone” and “direct contact” are verbal ways to elicit and acquire knowledge.

To complete the learning cycle, knowledge can be acquired from outside the organisation and must be stored in processes (capturing knowledge).

To address this topic, a question about the ways the organisation regularly captures knowledge from outside was introduced. The participants could select more than one answer.

	Percentage of answers
knowledge acquired from other industry sources: associations, competitors, clients and suppliers	77.8%
knowledge acquired from public research institutions including universities and government laboratories	100.0%

Table 3: External sources for knowledge acquiring

The geographical location close to the University of Greifswald triggers a constant exchange of information among neoplas GmbH, the INP Greifswald and the academic Institute of Physics.

In addition, neoplas GmbH is a member of BalticNet-PlasmaTec, a network platform for establishing cooperation among academic institutions, public facilities, private companies and individuals from the Baltic Sea Region (BalticNet-PlasmaTec, 2012). The partnership contributes to capturing knowledge by both sides (Table 3).

A commentary on the question summarises the origin of external knowledge: the products of neoplas GmbH are based on knowledge. By researching, people acquire knowledge, which should refine the products. There is knowledge experience, which comes from the industry and means the knowledge of problems in practice.

The last question was about projects results. It was framed to identify if the results from research and tests are documented and used to carry out future projects.

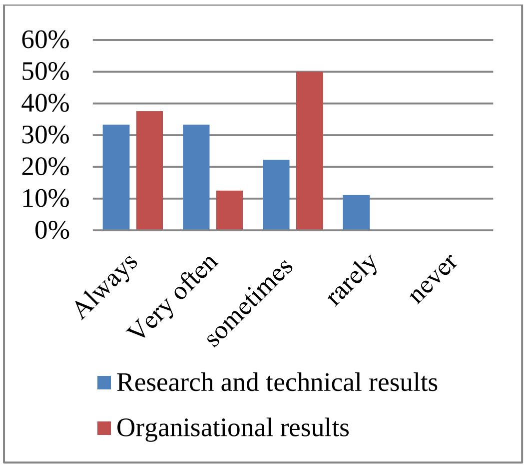

Figure 4: Reporting of results and their use for running future projects

66.6% of the respondents said that research and technical results are always or often documented.

Organisational results refer to administrative activities or contributions to the organisational environment. Although one person skipped the question, the respondents reported organisational results, but not regularly (50%).

After studying the data, a new qualitative analysis was carried out to compare the mapping of KM tools with the theoretical insights presented in chapter II.

4.4 Relating collected data to KM theory

According to Davenport & Prusak (1998), Rao (2005) and APO (2010) there is a range of instruments, by which knowledge is created, shared and used in organisations.

Considering the classification of KM instruments into people, technology and processes, the dimension "processes" can be analysed as a way to bring people to work together. For that reason, that is included in the description of the dimension "people".

4.4.1 Knowledge management: people and processes

The following KM tools related to people and processes were identified in neoplas GmbH: peer assistance, knowledge clusters, brainstorming, learning and capturing ideas and after action review.

Most of the workers classified learning from colleagues or peer assistance as important for their activities. The constant exchange of information among scientists and engineers from the INP-laboratories and product designers from neoplas GmbH illustrates this point. Informal meetings also contribute to learning. For example, in breaks people talk openly, facilitating the exchange of information.

Knowledge clusters are formed by organisations that are based on knowledge production and its dissemination in the market (MRPA, 2008). The relationship that exists among the University of Greifswald, the Leibniz Institute for Plasma Science and Technology and neoplas GmbH is an initiative in interacting scientific and applied research with businesses.

Brainstorming is strongly used in the organisation. Usually it occurs through spontaneous initiatives of employees during the first phases of a project.

The learning and idea capture process also exists in the organisation. Scientific articles and personal notes illustrate this instrument.

After action review is a technique used to aid team and individual learning during the work process (APO, 2010). Considering the report of research and technical results, as well as organisational results, the technique is practiced. While preparing the documents of a project, employees can reflect on their assignments and the project results.

In conclusion, the analysis of these tools shows that neoplas GmbH makes use of KM tools, but largely without being conscious of using them.

4.4.2 Knowledge management: technology

Knowledge management requires technologies that provide ways to organise, store, and access explicit knowledge. Databases, social media and social networking, collaborative virtual workspaces, video conferences, e-mail and groupware are technological tools used in neoplas GmbH.

Neoplas GmbH has a central database, which is run by Lotus Software. It releases a groupware and e-mail system, the Lotus Notes. All employees have access to databases according to their responsibilities, for example employees, who work on a temporary-contract with the INP Greifswald, have access to relevant INP databases. However, the technology is not considered as an important instrument to store and share explicit knowledge.

The team concerned with technology marketing occasionally makes use of social media. For example, the team has two Facebook profiles to promote its ideas. However, most of the workers see Facebook as a private social media and do not use it for work activities.

Collaborative virtual workspaces, phones and the web are common technological tools to contact people. Other similar ways to communicate, such as video conferences, Adobe Connect and Skype are used by managers to contact national and international partners.

The tool groupware includes features as group document creation, notification, and sharing of information. The Lotus Software is designed to provide integrated collaboration functionality, including e-mail, calendaring, contacts management, backup of information and access to databases. Therefore the organisation makes use of some groupware features. E-mail is fully implemented.

The data shows that neoplas GmbH implements KM-technological tools. On the other hand, the tools are not structured around organisational activities. The report of information and data concerning projects could be reinforced to improve knowledge storing.

5 Conclusions and recommendations

The conducted case study systematically describes activities and attitudes related to knowledge management, in order to find out which KM tools are used in the organisation.

The knowledge conversion phase “socialisation” is stimulated within the spin-off through a collaborative environment and technical cooperation. The applied KM techniques, such as peer assistance and brainstorming enable the creation of a positive organisational culture, giving a contribution to knowledge sharing through observation, group discussion and speech.

The process of transforming explicit knowledge into tacit knowledge – internalisation – is observed in daily work activities. The team exchanges e-mails daily and has access to databases; all these activities enable employees to acquire new information.

The organisation uses tools that make tacit knowledge explicit – externalisation – and also employs processes that convey explicit knowledge in documents, e.g. e-mails – a type of combination. Nevertheless, such instruments are not structurally integrated into organisational processes. Therefore, three points are discussed anew in this section in order to reinforce the use of KM tools in the context of explicit knowledge.

Databases are unimportant or not important to the work (66.7% of responses) and consequently not used for storing technical data and project results. On the other hand, personal notes are often used. 100% of respondents said that this technique is either very important or important to their work. Considering both tools, they can be used as a starting point for a knowledge base. The organisation could provide a base to edit work notes, store and update such information, for instance, through a wiki or even a platform for group discussion.

Another suggestion is concerning partnerships. Neoplas GmbH cooperates with different organisations, such as the INP Greifswald, neoplas control GmbH, neoplas tools GmbH, BalticNet-PlasmaTec and seven other institutions of the Research2Market Consortium. A close cooperation across organisations on technical and market research, as well as the sharing of best practices could be used to improve the business model of the spin-off and to reduce organisational costs.

In the context of knowledge management, KM tools are also used for improvement of business strategies. Therefore, the design of the information flow and people’s interaction within the organisation could improve the spin-off business model.

Neoplas GmbH was chosen as the case study due to the origin of its creation and its business procedures, which link the organisation to knowledge management and transfer. Furthermore, plasma technology is a study field that requires scientific expertise and background, which can be improved by sharing experiences among employees and retaining such information in the company.

The intensive analysis of a small business contributed to emphasise the relevance of KM tools for the processes of knowledge sharing and storing within the organisation. Knowledge management showed to be also a strategic way to manage expertise through networks and carry out new joint projects.

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Developing University-Business-Cooperation In Economically Underdeveloped Regions: The Industry-Academia Liaison Officer (Wirtschaftstransferbeauftragter/Wtb)

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Abstract

This paper presents a case study of a university-driven regional public-private partnership to foster strong, innovative and effective UBC in a regional environment that is marked by relatively low levels of industrialization, net product and private sector investment in research and development.

Since January 2011, all five Higher Education Institutions (HEIs) in Mecklenburg-Vorpommern-Vorpommern (MV) employ an industry-academia liaison officer (Wirtschaftstransferbeauftragter, WTB).

Although comparable to technology transfer offices - a standard feature in European universities - the WTB approach is different in that it explicitly aims to elicit the innovation needs of the regional business sector, thus enhancing prospects for economic utilization as well as the market relevance of the research conducted at the HEIs.

The WTBs are concerned with tackling the structural deficits of UBC in MV, which are lack of both awareness of the potential benefits of UBC, and platforms for managing the complex nature of regional UBC, inadequate financial resources on the part of the regional business sector for R&D activities, and a shortage of skilled staff. Through the WTB network, it is possible to raise awareness of the benefits of UBC, pool the different competencies in research and development of regional research institutions, elicit the innovation needs of business actors, identify potential for cooperation and thus connect academia and business in a region where institutionalized platforms for cooperation between the two are scarce. The WTB network is currently financed through EU Structural Funds, however the co-financing of the WTBs by the participating universities and regional business associations (Chambers of Industry and Commerce, Chambers of Skilled Crafts) reflects the incentives both sides for improving UBC.

The general findings after 2 years of implementation are positive. Indicators for evaluation of the success are

- Established business-academia contacts
- Initiated R&D projects
- Established networks

The WTBs have proved to be highly successful in connecting actors in business and research, especially in fostering the awareness of the potential benefits of UBC. The feedback from business actors shows that they particularly value access to dedicated contact persons, who can introduce them to researchers and mediate the initiation of R&D cooperation with universities. Whilst it is too early to evaluate the success of the project in detail, one major quantifiable success, a € 1.2 million collaborative research project between the University of Greifswald and BMP Bulk Medicines & Pharmaceuticals GmbH is presented in the paper.

The WTB approach has proved its usefulness and potential in:

- connecting business and academia
- initiating regional research clusters in application orientated fields
- communicating the needs for specific innovations of business actors to researchers in universities

Evidence from the WTB network in MV, suggests that the industry-academia liaison approach should be a key instrument for institutionalising cooperation between HEIs and regional business associations and their members. Given the intensive social capital invested by the WTBs to build relationships between researchers and the business sector, the approach demands continuity in staffing, hence a longer-term finance model is necessary.

Keywords
University-Business-Cooperation, strategies, drivers of UBC

1 Introduction

This paper presents an innovative tool to address the challenge of developing effective UBC in a rural region of Germany: the installation of business-academia liaison officers at all five Higher Education Institutions (HEIs) of the region in cooperation with the Chambers of Industry and Commerce as well as the Chambers of Skilled Crafts. The paper investigates how the WTBs contributed to promoting UBC in the first year of the implementation of the project.

The paper gives a detailed description of the problem addressed and the approach identified to solve it (part II). The main findings (part III) are presented, discussed and interpreted (part IV). The conclusion (V.) summarizes the argument and gives suggestions and recommendations.

2 Problem and approach to solving the problem

2.1 Problem

The problem addressed in this paper concerns the obstacles and possibilities to establish effective and efficient UBC in the German federal state of Mecklenburg-Western Pomerania (MV). In the national context, MV is marked by relatively low levels of industrialization, net product and private sector investment in research and development. The economic structure of the region is dominated by small and medium-sized enterprises (SMEs) with an average of 20 employees. There are five HEIs in MV: The universities in Greifswald and Rostock as well as the universities of applied science in Neubrandenburg, Stralsund and Wismar, all of which conduct practice-oriented research. However, the respective academic expertise is not matched by a sufficient number of “customers” from the regional business and industry sector. Furthermore, the business actors often lack the necessary absorptive capacity.

With regard to UBC, the following major obstacles are characteristic for the region:

(1) Most of the relevant actors are unaware of the potential benefits of UBC as well as possible partners, forms of collaboration etc.

(2) The majority of existing regional UBC is carried out on the level of individual cooperation: there is no encompassing and coherent platform for managing the complex nature of UBC, information exchange, networking etc.

(3) The prevalence of small enterprises also constitutes an obstacle, since the limited financial resources of these enterprises often prohibit extensive investments in R&D activities and thus contribute to a relatively low level of investments by business in UBC. Regarding the business investments in R&D activities, MV is the antepenultimate of the federal states in Germany, although a positive trend can be recognised (Wissenschaftsstatistik 2012). Additionally, programmes for the public (co-) financing of UBC activities are largely unknown to the relevant actors.

(4) The steady decrease of the population of MV – the federal state has lost 15 percent of its population due to migration and a decline in birth rates since 1990, making it the German federal state with the lowest population density (Statistisches Amt 2011) – contributes to a shortage of skilled staff. This negatively affects UBC in two ways: first, many SMEs place higher emphasis on securing skilled staff than on developing R&D activities. Second, where the need for R&D activities is recognized, the SMEs often lack the qualified personnel to realize these activities.

The obstacles to effective and sustainable UBC in MV outlined above demand an innovative approach that effectively addresses each obstacle while also paying attention to the interrelations between them.

2.2 Solution

Since 2010, all five HEIs in MV employ a business-academia liaison officer (Wirtschaftstransferbeauftragte/r, WTB). Their main tasks can be summarized as follows:

(1) Facilitate access for business actors to regional university and non-university research institutions

(2) Foster and mediate concrete cooperation projects between business and academia

(3) Act as a contact person for business actors

(4) Acquire business contacts for HEIs and researchers

(5) Initiate and establish UBC-networks and connect them efficiently with existing networks

(6) Find graduates for SMEs suffering from a skills shortage

The tasks of the WTBs are designed to tackle the practical problems of UBC in economically underdeveloped areas, although in diverging intensity. Evidently, the focus of the WTBs lies in addressing the first and second obstacles presented above, that is, raising the awareness of the potential benefitss of UBC, providing information, establishing networks, and initiating and building relationships between the relevant actors etc. As will be seen below, the third problem (financial resources/funding) can be addressed only indirectly, although nevertheless in an effective manner. Further, it has to be noted that the WTBs are primarily concerned with establishing *new* business contacts – the management and development of already existing cooperation is not included in their portfolio.

As can be concluded from their job description, the WTBs are meant to act as a "translator" and "catalyser" between the different actors relevant for successful UBC. However, the focus lies on offering industry information on the potential benefits of UBC and financing opportunities and the establishment of a network of identifiable and dedicated contact persons. As will be argued below, this approach works most effectively when integrated in complementary structures for supporting UBC.

The incentives of all parties in the triple helix (Etzkowitz and Leydesdorff, 1997) – universities, industry and (federal) government - in developing UBC in MV is reflected in the innovative model of financing of the project: the WTBs are co-financed by the federal state of MV (with funds from the European Social Fund ESF), all five universities as well as regional business associations (Chambers of Industry and Commerce, Chambers of Skilled Crafts). The implementation period of the project is from January 2011 to December 2013, although the effective start of work ranged between February to October 2011 for the five WTBs. The respective foci of expertise for each WTB is determined by the research and teaching activities at the university at which they are based (cf. tab. 1):

HEI base for WTB	**Specifications**
Greifswald	medical technology, pharmacy, biotechnology
Neubrandenburg	food economy and technology, organic product technology, geoinformatics
Rostock	energy, climate control technology, marine technology
Stralsund	Information and communication technology, energy technology
Wismar	renewable energies, environmental technology, energy efficiency and sustainable logistics

Tab. 1: Specifications of the WTBs

Moreover, the model of financing is also partly mirrored in the institutional embedding of the WTBs, with each WTB assigned to both a HEI and a business association. Regarding the embeddedness in a UBC-friendly environment – a point that will be further elaborated below – it is helpful to briefly examine the situation at the five HEIs.

At the University of *Greifswald*, the WTB is integrated into the universitary Centre for Research Support and Commercial Services, an institution established to support both the acquisition of third party funding and the commercial exploitation of research results.

Similarly, although less institutionalized than in Greifswald, the WTB in *Neubrandenburg* cooperates with the research manager and the knowledge transfer officer.

In *Rostock*, the Centre of Project Conception and Project Management is concerned with the acquisition and management of third party funds and general research support activities. However, the cooperation between the WTB and the centre is rather selective, the WTB being primarily engaged in acquiring new business contacts (see above).

The Technology and Information Transfer Centre in *Stralsund* has a clear focus on facilitating access to the HEI for business actors and personal transfer between academia and business, which is highly compatible with the tasks of the WTB. However, a unit specializing in acquiring third party funding and research support does not exist.

The WTB in *Wismar* is located at the Robert-Schmidt-Institute (RSI). The RSI's core activities include networking and establishing contacts in career development, further education for supporting start-ups, supporting experience exchanges, networking and cooperation as well as research on central themes of start-up and regional development. The WTB collaborates also closely with the universitary Research and Innovation department and the Forschungs-GmbH Wismar, a subsidiary service company specialized in project management, research support, research marketing and the development of R&D projects.

As can be seen, the institutional embedding of the WTBs varies noticeably between the five HEIs. Although a comprehensive analysis of the impact of the institutional context and embeddedness of the WTB on the success of their work cannot be given in this article and at this stage of the project, exemplary evidence of its importance will be discussed later in this paper.

The WTBs employ a "double" networking strategy. Each WTB aims to establish a both flexible and coherent network of competence in his/her field of activity, bringing together the relevant actors from business and academia and maintaining close contacts with public institutions like local/regional administrations, ministries etc. Additionally, through the WTB network, the WTBs identify cross-sectoral and interdisciplinary possibilities of UBC and potential synergies. Thus, a complex regional web of expertise and triple-helix-contacts develops.

Regarding the means of fulfilling these complex tasks, the WTBs employ an integrated approach, which primarily consists of:

- Establishing personal contacts to and between actors from industry and academia as well as politics/administration
- Communicating the benefits of UBC to all relevant actors
- Identifying potential for cooperation and mediating concrete UBC projects
- Advising actors from business and academia with regard to funding opportunities and project partners

The majority of the above mentioned activities are conducted via personal contacts, e.g. at conferences and workshops. A more targeted tool – especially in the consolidation phase of the project - is on-site visits to firms. There, the WTB can determine the needs of the specific business, and inform senior staff about UBC in general and the specific competencies of his/her university in particular. In the first year of project implementation, the five WTBs held 198 meetings with business actors (see also III.). Since on-site visits require a considerable expenditure of time, these activities are complemented by less time consuming ways of contacting and informing business actors, mostly via phone or rather indirectly via social media (facebook, xing!).

Additionally, the WTBs also engage in scouting and screening activities both in the regional business landscape and at their own HEI to identify potential areas for cooperation. These matching activities have the potential to foster the (leading) role of the HEIs in the regional innovation systems. As Uyarram (2008) points out: “An emerging concern is therefore the need to align or match regional knowledge producing networks with regional firms.” (12). In the medium to long run, the thematic specialisations of the WTBs and their comprehensive knowledge of the regional business landscape will also help their HEIs to develop specific transfer strategies and thematic core areas of innovative, practice-oriented research. This matching of the specific expertise of the universities with the needs and potential of the local industry is, according to the findings by Siegel (2007), a valuable alternative to the option of general commercialization and transfer activity, especially for small- and medium-sized universities. From a policy perspective, it also constitutes an important step in the formulation and implementation of Regional Innovation Strategies (RIS).

3 Main results/ findings:

The general findings are largely based on the data available from the annual reports of the five WTBs. However, certain aspects concerning the validity of the data have to be remembered: First of all, due to the “time gap” in delivering the reports, data for all WTBs is only available up to March 2012. Furthermore, the data is drawn from the indicators used to measure criteria for success defined within the project, which are:

(1) Contacts with business: including primarily personal contacts, information about the WTB approach, gaining information about the respective enterprises etc.

(2) Impulses for cooperation: identifying prospects for cooperation between business and academia, project ideas that have not reached the phase of concrete cooperation

(3) Projects, mediated cooperation: all concrete activities in the business-university-cooperation, including joint events, collaborative projects, orders to third parties, mediated staffing/internships etc.

(4) Project funding applications: concrete collaborative project proposalss that have been submitted to public or private funding bodies

As can be seen, the indicators are neither not clearly defined nor discrete, and thus they are to a certain degree open to interpretation. The potential problems and limitations of this will be further elaborated in the concluding section below.

For a first presentation of the main results, the indicators from the annual reports will be used to evaluate the performance of the WTBs in their primary tasks, introduced in the section above. How the WTB approach could contribute to the development of UBC in MV will also be discussed.

3.3 Peformance of the WTBs

Task a: Facilitate the access of business actors to regional university and non-university research institutions

Findings: Via attendance of conferences/ workshops, presentations, business-specific events, personal talks, visiting businesses and the publication of public relations material, the WTBs were able to communicate to business actors the possibilities for UBC in general as well as concrete projects. Through the WTB network and the expertise of the individual WTBs, it was possible to provide specific information on cooperation partners to the respective business actors. The provision of transparent information enhanced the understanding amongst business actors of the expertise and functioning of university and non-university research institutions in MV. Furthermore, through the continual input by business actors, the WTBs were also able to communicate the specific needs for innovations from business to the academia. Another point of relevance concerns the access of industry to graduates and other experts from the HEIs. Here, the WTBs proved especially valuable in mediating contacts for internships and regular staffing.

Task b: Foster and mediate concrete cooperation projects between business and academia

Findings: The WTBs proved to be highly successful in initiating new projects during the first period of implementation. Table 1 gives an overview of indicators 2-4, which are most significant here, for the first year of project implementation:

Impulses for cooperation	128
Projects, mediated cooperation	70
Project funding applications	5

Tab. 2: Cooperation

The limitations of the validity of the data notwithstanding, it is to a certain degree consequential that especially given the short timespan for establishing concrete projects during the starting/ consolidation phase of any initiative, the WTBs have already delivered five project applications. This demonstrates that collaborative projects are already emerging from the WTB activities. Additionally, at the end of 2012 a first major quantifiable success became visible with the initiation of a € 1.2 million collaborative research project between the University of Greifswald and BMP Bulk Medicines & Pharmaceuticals GmbH. This case study will be further elaborated as a good practice example in the next section.

What the indicators above demonstrate is that the WTB have clearly been successful in fostering communication and interaction between industry and academia in MV. Through their comprehensive information and communication efforts, the WTBs provide the basis for developing concrete projects and integrated regional UBC.

Task c: Act as a contact person for business actors

Findings: The feedback from business actors shows that they particularly value access to identifiable and dedicated contact persons, who can introduce them to researchers and mediate the initiation of R&D cooperation with universities. An important tool proved to be the constant communication of the availability of a dedicated contact person, e.g. via the website of the respective university, social media, and personal interaction. Over time, this “low threshold contact” was used by business actors to an increasing degree at all participating HEIs.

Task d: Acquire business contacts for universities and researchers

Findings: The findings are highly similar to those for tasks a and d. Academic actors were given regular information on the regional business landscapes, specific demands from business actors, events etc. However, specific requests for cooperation partners from the business sectors were rather uncommon in the first year of project implementation. The WTB's activities thus focused on achieving a R&D-friendly atmosphere among researchers, who tended to be primarily oriented towards basic research.

Task e: Initiate and establish UBC-networks and connect them efficiently with existing networks

Findings: The WTB approach has proved its usefulness in establishing regional networks of competence between actors from academia, business and politics in specific fields of application-oriented research. As already outlined in the above section, the WTBs employ a two-tiered networking approach. On the one hand, each WTB aims to establish and maintain a coherent network of competence and information exchange in his/her own area of specialization (see above). Additionally, through frequent internal meetings and information exchange, the network of the five WTBs forms the basis for an integrated approach to foster UBC in the whole region. Of course, there was also a close cooperation with existing networks in these fields, e.g. for the case of Greifswald with the Greifswald University Club (GUC), a non-profit organization aiming at fostering business-academia-cooperation. The two approaches are highly complementary in this case, since the GUC explicitly addresses businesses from outside MV as well as regionally based companies.

Whilst it is too early to comprehensively evaluate the success of the project the first general findings are considered to be highly positive.

4 Discussion of main results

Reflecting the overarching aim of the WTB programme to foster UBC in MV, the preliminary findings will be discussed on different levels: first, a case study – the collaborative research project between the University of Greifswald and BMP, mediated by the University Greifswald WTB – will be presented in more detail to exemplify the different activities of a WTB and emphasize certain important points for the subsequent discussion. After that, the findings will be discussed in the specific context of developing UBC in economically underdeveloped areas, before the focus turns to the wider context of obstacles and drivers of successful and sustainable UBC.

4.1 Case study: Cooperation between the University of Greifswald and BMP

The collaborative project between the University of Greifswald and Bulk Medicines & Pharmaceuticals Production GmbH (BMP) is a case study of how the different activities of the WTB can foster UBC and, also, in which circumstances they work best.

BMP is an SME situated in Parchim/MV that specializes in pharmaceutical production and logistics. The WTB based at the University of Greifswald fostered the development and realization project proposal, as the cooperation between the company and university researchers passed through different stages. However, the initial contact in early 2011 came from BMP contacting the WTB in order to find academic partners for a collaborative project. After eliciting the details of BMP's project plans in a personal meeting, the WTB was – due to his related thematic foci (see above) – able to identify a research group at the university with matching research interests. Further meetings between representatives of BMP and the research group – moderated by the WTB – led to a rapid development of the project idea. With support from the university Centre for Research Support and Commercial Services, a draft proposal of the project was submitted to the TBI (Technologie Beratungs Institut GmbH, the executive agency that runs the funding programes of the Ministry for Economy, Building and Tourism of Mecklenburg-Vorpommern) and subsequently positively evaluated. For the voluminous task of preparing the main proposal in the second stage of the two-tiered procedure, the WTB brokered a three-month employment position for a university graduate at BMP. She was afterwards employed in the project itself. The main proposal was finally approved by the TBI in late 2012, with an overall volume of € 1.2 million, half of which was received by the university (full financing), the other half split equally into funding and own contribution for BMP. Additionally, links between BMP and the university can by no means be reduced to this single project, rather they have developed during and after the project application. Cooperation is manifold and includes for example a financial contribution by BMP to a junior professorship at the Center for Drug Absorption and Transport (C_Dat), one of the university's leading interdisciplinary research centres, the participation of a senior BMP manager in the jury of the UNIQUE Idea Competition – a university-run competition aimed at fostering start-ups from scientists and students – as well as cooperation with the ear surgery unit at the University Hospital, where initial project plans have already been formulated.

This case study exemplifies possible advantages of the WTB approach. *First*, it shows how the existence of an easily identifiable, dedicated contact person was the starting point for the whole project. *Second*, the scouting and screening activities of the WTB at his own HEI facilitated the search for cooperation partners from the academia. *Third*, through moderating the initial project development, the WTB fulfilled the envisaged role as a "translator" between business and academia. *Fourth*, the integration of the WTB into other university institutions which are dedicated to developing UBC – in this case the Centre for Research Support and Commercial Services, the key task of which is assisting the researchers from the university in acquiring third-party-funding – proved a major factor in the development and success of the project. *Fifth*, the WTB also was able to broker personal exchange between business and academia. And *sixth*, the concrete project obviously generated prospects for continuing and widening cooperation between enterprise and university.

4.2 UBC in economically underdeveloped regions

Drawing on the insights from this best practice example, the contributions of the WTB approach in addressing the problems of UBC in economically underdeveloped areas will be discussed.

The WTB approach offers certain advantages that make its application especially suited to economically underdeveloped areas, and the obstacles to UBC faced there:

(1) The WTBs are a valuable and tested tool for raising the awareness of the benefits of UBC among all relevant actors. The structure of the region analysed here particularly suits the approach of personal contacts since the number of major actors – in academia, business, and politics – is a manageable figure and thus personal contacts can feasibly be established and maintained.

(2) Through the double-networking approach, the WTBs foster UBC that goes beyond individual impulses for cooperation. Via their contacts, the WTB created a pool of possible cooperation partners and thus can identify potential for productive collaboration. Furthermore, the WTBs present and communicate successful cooperation as best practice examples.

(3) The limited financial resources of SMEs to invest in R&D activities can not be directly resolved by the WTBs. Nevertheless, the WTBs can inform business actors about appropriate funding opportunities. Also, the WTBs can identify and communicate possible synergies between the innovation needs on the part of industry and matching research conducted at the respective universities. Furthermore, it is necessary to embed the WTBs in a supporting environment, with institutions that have expertise in the fields of funding/financing, legal frameworks, IPR etc. The University of Greifswald provides a good example in this respect: the WTB is integrated – organizationally and spatially – into the Centre for Research Support and Commercial Services, which was founded in 2007 especially to support the acquisition of third party funding.

Regarding the suitability of the approach to economically underdeveloped areas in general, the following advantages can be summarized:

First, the WTB approach is relatively easy to implement, although it is preferable for the holder of the position to have not only excellent communication skills, but already on appointment a sound knowledge of the regional business and research landscape as well as a pool of personal contacts. *Second*, the approach is especially suited to develop the “basics” of UBC via personal contacts and information. Having a dedicated and low-threshold contact option at local/regional HEIs is of greater importance in light of the findings of Drejer and Vinding (2007), who emphasize that businesses with rather low absorptive capacity – and it is argued here that most of the regional SMEs in MV belong to this category – are very likely to approach geographically near universities when seeking UBC for innovation. *Third,* and related to the second point, the number of the most relevant actors – at least at the side of the business sector, is of a manageable amount, which facilitates the establishment and maintenance of personal contacts.

Given these advantages, the concept has high transferability for other regions with similar structural markers.

4.3 UBC in general

The last part of the discussion will focus in brief on the impact of the WTB approach with regard to general UBC. The discussion draws here on major insights of the seminal study *The State of European University-Business Cooperation,* conducted by the Science-to-Business Marketing Research Centre in Münster, Germany (2011).

First, the WTB approach is a potential tool for dealing with the complex and integrated nature of UBC. Although the WTB approach focuses on the relations between business and academia, steady contact with politicians and administrations is exercised by the WTBs to ensure that all relevant actors from the triple helix are sensitized for the mutual benefits of effective UBC. Furthermore, the "double-network" approach ensures that the WTBs activities to promote UBC do not occur in isolation but form part of a wider regional development context.

Second, the WTB approach also promises to be highly successful in addressing the "personal" level of UBC. Through manifold and steady personal contacts, the WTBs are able to generate trust both in their own role and in the partnerships/cooperation they mediate. They are also an important element in enhancing the willingness to engage in UBC by individuals in both academia and business. As has already been demonstrated in the literature, the exchange of "tacit knowledge" in UBC – not in a codified form as in patents and publications –is to an especially high degree dependent on intensive personal contacts and geographical proximity (Fristch, 2001; Hewitt-Dundas, 2013). In this sense, the WTBs act as drivers for enhanced UBC, continuously communicating and demonstrating the benefits of UBC to the relevant actors.

Third, the WTB activities have to be embedded in a UBC-friendly environment. Drawing on the 4 pillars of UBC identified in the Münster project – strategies, structures and approaches, operational activities, framework conditions -, the University of Greifswald may serve again as an example:

A comprehensive *strategy* of the University for developing UBC does not exist. However, *structures and approaches* of the HEI in this area are clearly identifiable, including e.g. the Centre for Research Support and Commercial Services or the Competence Centre COAST-FunGene, which is located at the interface of business and academia and which is designed to promote interactions between both sides in the area of functional genomics. Similarly, the university is willing to support and initiate *operational activities*, the installation and co-financing of the WTB itself being an appropriate example. Last but not least, the *framework conditions* are generally positive, with the state government both providing funding opportunities for collaborative projects and co-financing the WTBs, and stating in the coalition agreement that the further development of UBC constitutes one of the major tasks for the current legislative period. Furthermore, the WTB-project is accompanied by a strategic advisory board (TIWW - Technologie- und Innovationskreis Wirtschaft Wissenschaft) consisting of representatives from ministries, HEIs, non-university research institutions and Chambers of, thus mirroring the structure of the triple helix.

In the ideal case, a UBC-supporting environment and the WTB strengthen each other in the development of effective UBC.

5 Conclusions

5.1 Summary

This article aimed to present and discuss an approach to tackling the difficulties of developing and strengthening UBC in an economically underdeveloped region. It could be shown that the WTB approach is useful in this regard, although with certain limitations (see below). The individual WTBs proved to be highly successful in "basic networking" – establishing personal contacts, informing SMEs about the benefits and possibilities of UBC and possible partners. At the next level, the WTB network laid the basis for an integrated management of regional UBC, which is clearly beyond the scope of a single actor. Via the network, a flexible regional cluster of competence develops and the potential for multi-actor- and interdisciplinary collaboration rises. For more concrete cooperation (project proposals, collaborative R&D projects) it is furthermore necessary that the WTBs operate in an environment conducive to stimulating UBC. However, given the fact that the WTB project is still in an early phase, and that collaborative projects in particular need time to develop, further research is necessary after completion of the project to evaluate its success in detail.

5.2 Limitations

Limitations of this paper concern primarily the indicators for evaluation and success. The data base for the evaluation is drawn from the semestral reports of the individual WTBs and thus to a certain degree dependent on their own interpretation. While some indicators can be operationalized clearly (e.g., businesses visited), others are less explicit, e.g. in the case of "initiated projects". Furthermore, even in concrete and realised projects, the role of the WTB in the process is sometimes hard to assess and can only be gauged from the accounts of the participating actors. The case study of the cooperation between BMP and the University of Greifswald served to illustrate the contribution of the WTB at least in one example. Nevertheless, the points mentioned above certainly limit the validity and generalizability of the results.

5.3 Recommendations

The WTB approach is a suitable tool for developing UBC, particularly in economically undeveloped areas. For effective implementation the following aspects have to be considered:

- Given the importance of personal contacts and the extensive social capital invested in the build-up and cultivation of these contacts, the approach requires continuity in staffing.
- The WTB should be embedded in a UBC-supporting institutional context and his/her activities should be integrated with the activities of other relevant actors (see above). Where this environment is lacking, the WTB should be in a position to propose appropriate changes to the management of his/her HEI.
- The WTB should be equipped with funds for public relations, travel and the organisation of events.

5.4 Suggestions

For the specific case of Mecklenburg-Western Pomerania, it is suggested that the WTB approach should be institutionalised and thematic meetings with actors from the triple helix should be sustained on a regular (at least annual, preferably semestral) basis to create a regular forum where matters of regional UBC can be discussed. The WTBs should conceptualise and organise these meetings, suggesting the topics and the participants as well as moderating the events.

Given the structure of region analysed here and the limited number of relevant actors, the next steps should also focus on activities going beyond the federal state. A gradual extension to neighbouring federal states – preferably in fields where UBC is already well developed– is just as attractive as an internationalization of the concept within the framework of the Euroregion Pomerania, as well as the South Baltic region of which MV is a part.

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A Discussion On The Concept Of Industry To University Transfer:
The Practitioner's Case Fohxes – A Spin-Off Incubation Project Enabled By Metal Foam IP Obtained Via Industry To University Transfer

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Abstract
University-industry interactions (UII) typically deal with a transfer of rights from the university to the industry. This paper, on the other hand, is about transfer in the opposite direction, i.e. one whereby rights are transferred from industry to university. Based on a practitioner's case the general concept of Industry to University Transfer (IUT) is introduced. A preferential framework for negotiations is proposed.

Keywords
Spin-off, metal foam, IP, technology transfer

1 Introduction

Many collaborations between industry and universities, university-industry interactions (UII), include a contractual agreement related to the results of this collaboration. Such agreement typically stipulates the rights for both parties related to ownership and commercialisation of the results. Most commonly, for industry funded collaborations, this includes a transfer of rights from the university to the industrial partner. Depending on the amount of university background IP that was contributed to the collaboration, two common types of agreements are (1) all results are owned by the university, with specific (non-exclusive and/or domain-specific) commercialisation rights for the industrial partner and (2) foreground results are transferred to the industrial partner, with a license on the university's background, and with a lump sum or royalty payment in case of commercialisation success.

A transfer of rights in the other direction, i.e. from industry to university is clearly less common. In this paper we present such a case: the spinoff incubation project FOXHES running at Ghent University. It is the first time such a reverse industry to university transfer was set up at Ghent University. The original collaboration project between the company and Ghent University was internalized at the university into the project FOHXES with the purpose to set up a spin-off.

This paper starts with the FOXHES case study and uses it to illustrate and support the subsequent discussion on the potential enablers and pitfalls in a reverse UII i.e. where rights are transferred from industry to university. The paper is therefore structured in two parts: a Part A that contains the practitioner's case and a Part B that covers the conceptual discussion.

In the first section of Part A, the traditional university to industry collaboration project that was originally set up, is explained as well as the specifics of its funding scheme. In the next section, the impact of a change in plans within the industrial company is elaborated. This change led to the set-up of a new route towards commercialisation via the university, by setting up a university spin-off incubation project. This is discussed in the last section. To ensure all relevant IP for the spin-off was available from a single source, in this case the university, a new deal was negotiated leading to the concept of an Industry to University Transfer (IUT).

In Part B we further investigate the potential of this concept in a more general way. In the first section of Part B the enablers of this concept are discussed, while the second section deals with the potential pitfalls, and the third section covers some final remarks.

Finally conclusions are presented confirming the need for an appropriate pricing of the deal, availability of incubation funding within the university, and an industrial partner open to alternative business models.

2 PART A – A practical case

2.1 IWT Baekeland funding: the first UII

The practitioner's case relates to the topic of metal foam and more particularly aluminium (Al) metal foam as shown in Figure 1. As the figure illustrates, Al metal foam is a very porous material with a porosity of more than 90%. As of 2008 a multi-national metals processing company, further referred to as the Company, started to investigate and master the production process of such metal foams (De Jaeger2011). In parallel the Company also started actively looking for applications that would benefit from the unique characteristics of such materials (very light, high structural integrity, high porosity, high heat conductivity, easy to clean).

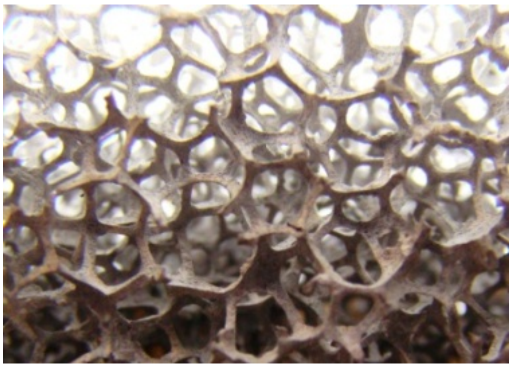

Figure 1: picture of metal foam

From the early start the use of metal foams in thermal applications such as heat exchangers was perceived as a very promising market. However, in order to fully grasp this opportunity it was required to understand the thermo-hydraulic properties of metal foams. Though some expertise and know-how was available within the Company it was felt that important knowledge was missing. Moreover, literature search proved that little was known about the thermal properties of such porous materials. Hence, to allow the commercialisation of its new product, important new knowledge needed to be built up. To that end the Company addressed Ghent University to assist them in creating the required knowledge.

At that time the Flemish Agency for Innovation by Science and Technology (IWT) had just launched a new research funding scheme that fitted well with the needs of the Company. The funding scheme, called a Baekeland mandate (IWT2013), consisted of subsidizing a company employee for a period of four years to obtain a PhD degree within one of the Flemish universities. In concreto, it means that the salary of the person, who remains on the payroll of the company, as well as some operational costs are half paid by the IWT and half by the company.

The Company enrolled the Department of Flow, Heat and Combustion Engines (FloHeaCom - prof. De Paepe) from Ghent University as the research group to host the PhD researcher. The targets for this PhD researcher were to work on the modelling of the thermal behaviour of highly porous materials such as metal foams in order to understand and to be able to design heat exchangers with targeted specifications and to develop simulation based design tools. Hence, the Company's employee was allowed to work for four years on obtaining a PhD degree. During this period he would be trained and coached at the FloHeaCom research department. After these four years, the results of this UII project would enable the Company to better commercialise the metal foam product for heat exchanger applications. In addition a highly skilled employee would be available to the Company.

With the arrival of the IWT/Company sponsored PhD researcher, Ghent University started to apply its expertise in heat exchangers to metal foams. As part of this first UII a contract was signed between the Company and Ghent University, stipulating that background knowledge including all improvements to any background were to remain with the party owning the background, while the industrial partner would become the owner of the project results, and the university would be the owner of the so-called generic knowledge (methodologies). Furthermore, it was also agreed that in case of commercialisation by the Company of the project results, both partners would negotiate a fair return for the university. Moreover, a publication clause was included. The project's starting date was April 1st 2009.

2.2 A change of plans

The project started as planned and soon resulted in some first research results. Mid 2011 however, the Company decided to stop all its metal foam activities and to concentrate on its core product activities. This decision was mainly a strategic choice to refocus, but was also taken because attempts to enter the market with metal foam products were until then not successful, partly due to the fact that the Company was not yet able to design optimized heat exchangers as the PhD research project and the required design tools were not yet finalised.

Fortunately, the Company allowed the PhD researcher to continue his activities, while still benefitting from the IWT funding. This was agreed upon because the skills that were acquired by the researcher (and employee of the Company) would be of further benefit to the Company even outside the application field of metal foam products.

It was in the beginning of 2012 that the PhD project started to deliver the required modelling, design and simulation tools for designing metal foams optimized for thermal applications. It meant that we were now starting to be able to design optimized heat exchangers using metal foams by being able to accurately predict their performance. One basic example is a tube covered with foam, a building block for many heat exchangers, as shown in figure 2.

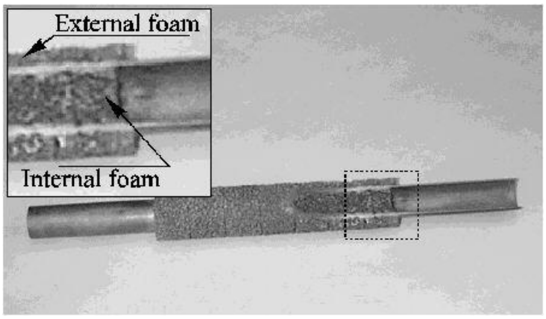

Figure 2: a tube with metal foam as can be used in heat exchangers.

More advanced and interesting applications using the benefits of metal foams were identified by the University researchers with support of the TechTransfer manager assigned to them. Applications include heat pumps, off road vehicles, power electronics and LED cooling, etc.. In these cases the USPs of metal foam (lightweight, robustness, anti-fouling) bring added value compared to other heat exchanger solutions.

As a result, the university's research group and the TechTransfer team of Ghent University started to believe strongly in the valorisation and commercialisation potential of the tools and the metal foam product.

2.3 IRF Stepstone funding

Given this believe in the valorisation potential, Ghent University decided to prepare the set-up of a spin-off company entering the market as "a thermal solutions provider in applications where metal foam is believed to benefit from its unique selling points." The project idea of Foam based Heat Exchangers for Energy Solutions (FOHXES) was born.

However, essential to launching such a spin-off trajectory is:

- To have an initial team, including at least one or two researchers, who are interested in driving the initiative from the technical and commercial side, and
- To establish early proof of concept, both technical and commercial.

The university was lucky to have already an interested researcher on board. The more commercial talent had to be looked for externally. Finding such talent is rarely easy as no firm job offering can be formulated at this stage. However, due to the available gap funding (as explained in detail below) such person, acting as a sort of entrepreneur-in-residence, could at least be paid for temporarily. Additionally this funding would also be used to develop prototypes for the technical and commercial proofs of concept.

Dedicated gap funding to allow the project to incubate was applied for with Ghent University, more particularly to the university's Industrial Research Fund (IRF) (IRF2013). This fund was especially created by the Flemish Government and instituted at each of the Flemish universities to stimulate them to interact more with industry and to create more economic impact from their scientific results.

The IRF funding received by the universities has to be used for two purposes. One is to pay for a business development team and the second is to provide gap funding for selected projects to help bridge the gap between scientific results and commercial deployment.

At Ghent University this business development team consist of about 20 business development managers, equally split over life sciences (medical, biotech, agro, veterinary, ...) and non life sciences (engineering, physics, chemistry, ...). Each business development manager is in charge of technology transfer and UII for a specific theme and represents a multi-disciplinary cluster of research departments active on this theme. To ensure a strong link with the research community the business development managers are stationed within one of the research labs of their cluster. They operate autonomously but can rely on a central technology transfer organization for support (legal, patenting, finance, strategy, ...). The FloHeaCom research department is member of the Sustainable Energy Technologies (SET) cluster, whose business development manager was instrumental in defining the metal foam business opportunity.

At Ghent University gap funding is provided through three types of IRF projects: StarTT Projects (75k€, explore business potential, clean up of software, ...), Advanced Projects (<150k€, industrial proof of concept), and Stepstone Projects (<500k€, commercial proof of concept).

In the FOXHES case, IRF Stepstone funding was granted for a total of €175k for 15 months starting from 1 January 2013. A possibility exists to apply for additional funding and to extend the project if needed. The project is currently proceeding as planned and all IPR on the results of this project will be owned by Ghent University. Currently, the date of incorporation of the spin-off is planned for no earlier than 2015.

Even before applying the IRF project funding, it was clear that in order to build a strong commercial opportunity it would be key to bundle the know- how and IP already owned by the Company with the newly created results from the university. For a future spin-off the bundling would allow for a strong differentiated IP portfolio. Additionally, it would avoid any freedom-to-operate (FTO) issues with respect to the Company. The Company's IP portfolio consisted of 4 patent applications and related know how.

Hence, access to the Company's IP-portfolio needed to be negotiated. As the spin-off would incubate within Ghent University, a not so common agreement was executed whereby intellectual property and know-how was transferred from industry to university, referred to here as Industry University Transfer (IUT). Several potential agreements were discussed and in the end the option of a transfer in ownership of the complete portfolio was opted for. As compensation for this transfer, Ghent University will bear all future patent related costs and the Company will be entitled to a fixed percentage of the return (shares and/or royalties) that Ghent University may receive from the spin-off. However, if no commercialisation of any of the Company's transferred IP occurs, Ghent University is due nothing to the Company. The shares or royalties Ghent University will obtain, will be the result of a typical, more common UII, whereby (ownership and/or commercialisation) rights will be transferred from the university towards the spin-off to be set-up.

3 PART B - the IUT concept

3.1 Introduction

The concept of industry university transfer in a broad sense is a common practice. One example of an industry university transfer is the "transfer", i.e. mobility, of people from industry to university. In Germany for instance many professors in engineering departments come from industry and bring important knowledge and know-how related to the industrial context (Norman 2007).

Another example is the transfer of materials, components or products from industry to university in order for the university to perform tests or to set up research programs.

Finally, the transfer of financial means from industry to university to execute a research program is perhaps the most common stretched interpretation of industry university transfer.

However in the FOXHES case the key "items" that were transferred from industry to university were not materials, people or money, but ownership of IP and associated know how. We will now focus and use the term IUT only for this specific form of industry to university transfer.

Clearly, the fact that there was a good understanding between the university and the company facilitated this process, but other enablers and pitfalls are to be acknowledged.

3.2 IUT Enablers

A number of enablers related to the IUT exist.

First, opportunities as described in the practitioners' case study do not come along naturally. No company starts an investment with the ambition to transfer it to a university. It requires an industrial research project that the university is familiar with and that has ended up in a distressed situation due to some technical issues that the university believes it can solve. In the practitioners' case several factors contributed to such a situation, but essential for the university to show an interest, was the fact the Company could not lower the technical risk level of the metal foam project fast enough. This made the project's internal rate of return (IRR) less and less attractive and was one of the reasons that made the Company decide to abandon the project. It also caused the Company to be more open to alternative ways to recover some of its investments and it made the Company agree on a transfer of the project and its risk at an acceptable price; acceptable meaning that pricing was not to be linked to sunk costs, nor to some unreliable over-optimistic market forecasts. No cure, no pay became acceptable to the Company. This made it an interesting opportunity for the university.

Market sentiment and structural changes occurring in certain industries, may make those industries more prone to distressed situations. In times of economic crisis there are budget cuts everywhere leading to non-core activities and costs to be scrutinised. Also industrial spin-out routes are then no longer an option due to a lack of resources. The transfer of IP to a university committed to valorisation can in such circumstances provide an alternative pathway to a potential return on investment.

Of course a university should not scout for an IUT of "distressed" projects when the distress is not partly due to challenging technical issues or when it has no clue where it can make the difference with respect to a company in solving the remaining technical issues. Domain specific scientific and technical acumen is key to be a credible university partner in an IUT.

Secondly, the main goal for attracting the company's IP should be the possibility to provide new insights based on complementary know-how, expertise, and IP from the university. This should lead to new insights into the application or usefulness of the transferred IP. As such, the transferred IP is allowed to further mature and the commercial value increased; one and one can equal three.

Thirdly, the university has access to gap funding to take over the investment. Availability of gap funding is key to be credible towards a company when negotiating a transfer. Typically universities have access to different kinds of financing channels compared to industry. These funding schemes do not necessarily, nor typically, target close-to-market research activities, Gap funding however is funding targeted at closing the gap between research and the market. Sometimes it is available from early stage venture capital funds, but when it is available through the university, gap funding is less return oriented and can much better tolerate a high risk of failure or a high uncertainty on a project's IRR.

Furthermore, a fourth enabler is a clear shift towards a commitment of universities to valorisation. However, timing remains essential to an IUT. Making a proposal to take over a project after the company has stopped the project may imply that there is no team left at the company to assist with the transfer or that assets and materials have been liquidated. Coming too soon and the Company may not yet feel enough pain to accept a loss, nor be open to a transfer.

However, when discussions for a transfer are properly timed, the university should show commitment through defining a clear commercialization strategy. Therefore, the university should apply for gap funding in parallel to negotiating the IUT. This provides a strong signal towards the industrial counterpart indicating the engagement of the university to actively pursue commercialisation of the IP to be transferred. It is such an engagement that provides a certain level of guarantee to the industrial counterpart that this transfer might bring some added value and can result in some return on their past investments. At the same time the university must confirm the high risk to keep the price low, but also demonstrate enough confidence that its people know what it takes to create a project turn-around.

The above approach and way of thinking also requires a change in culture at the university (in some EU countries this change is still occurring, other countries already have an established track record) wherein universities and their professors are more committed to valorise scientific results.

Finally, the university context provides a more or less safe and neutral place to transfer IP rights to. Unlike a young start-up company, the chances of a university going bankrupt are small and even though universities have no unlimited resources they are typically willing to invest for a longer period of time in their IP portfolio as it can be linked to the long term objectives or the researchers and research groups. Universities are also not (yet) perceived as competitors.

3.3 IUT Pitfalls

Next to the enablers, there are some evident pitfalls coupled with the concept of IUT.

First of all, as mentioned above, the university should have a commercialisation strategy in mind prior to starting an IUT negotiation. Along with this strategy should come human capital, a team should be available within the university to lead, tune and execute the strategy. Also essential in its subsequent commercialisation strategy is for the university to bundle and integrate the acquired IP with home-made know how, expertise, or IP. If the two above conditions are not fulfilled, it makes no sense for the university to get involved.

Secondly, it is clear that such a transfer will never occur for core IP of a company. However, companies may only have a limited amount of IP that is not related to their core business as they typically do not target investments in peripheral IP. In that respect the concept of IUT seems to be limited to medium sized to large companies with a strong culture of filing for patent protection early even in non-core activities, otherwise limited or no such IP will be present.

A further limitation is coupled to the sector in which a company operates. In some sectors companies build huge patent portfolios, even though most of those companies might never have any commercial intentions with many of their patents or patent applications. Patents, even unrelated to the core business, are not transferred, but are kept. The pile of patents they accumulate over time is used to create prior art for competitors, to avoid competitors taking rights too close to the core IP or as a chance to settle infringements. This situation is common in certain industries that rely heavily on patent portfolios for competitive posturing, such as micro-electronics, computer and communications systems, medical devices, biotech, ...

Moreover, an IP and know how IUT will neither occur when the Technology Readiness Level (TRL) (Mankins1995) is already high and time to market is important. In such case, universities typically can bring no added value and cannot gear fast enough to grasp the market opportunity. Key for a university to get involved is the existence of a clear need for additional research, and a sufficiently wide time to market window that allows for this research to be done..

Finally, there will inevitably be a discussion on a financial compensation for the company that is involved in an IUT. A few options will be discussed in the next section.

3.4 IUT Deal Structure

A first option in structuring a deal is for the university to simply buy all ownership and commercialisation rights from the industrial counterpart by means of a lump sum. Only in rare cases it is believed that universities are able and willing to bring hard cash to the table for IUT.

Moreover, the question arises what the value of this IP is and what basis to use in calculating this value, as discussed above. On the one hand, this IP results from investments done by the company in the past and hence this IP could be presented as very valuable. On the other hand, the actual value of this IP for the company based on the future outlook is close to zero (or even negative due to the patent costs) due to the absence of any further commercialisation plans. This can lead to difficult negotiations.

Therefore, alternative options may be better than an outright payment and IP acquisition. How to price a deal and to structure it depends on several questions:

- Does the company still wants to back license the IP for its own purposes?
- Does the university needs the IP only to obtain freedom to operate?
- Is the university entirely free in licensing the acquired IP to third parties?
- In any application domain?
- In any region?
- To competitors?
- Does the university needs the IP to establish a unique and exclusive position in a certain market?
- How much future investment is the university still planning to make prior to commercialisation?
- How big is the market opportunity the university is looking at?
- Can the university abandon acquired patents if it fails to valorise them?

Depending on the answers on the above questions, the university may have to consider the following elements in the deal structure:

- Back license to the company selling the IP
- Licensing limitations

Also depending on the answers on the above questions, the value of the deal will differ. The less constraints and demands the company insists on, the more valuable the deal becomes to a university. IP that is only needed to safeguard FTO is less valuable than IP that is needed because it creates a unique position in the market. If the university still has to perform a huge investment, the value of the acquired IP will be perceived lower.

No matter how the value is perceived by the university, in general, we would recommend only two payment alternatives:

- Totally free of charge, except that the university will have to bear all future patent costs and with a non-exclusive back license.
- The university bears all patent costs and shares the benefits with the company, the percentage of which remains an item of negotiation.

Below we give two examples.

Example 1: The university acquires IP ownership free of charge and gives the company a non-exclusive right to commercialize the transferred IP. The return for the company would then comprise the fact that it no longer has to bear the costs of the patent procedure while retaining the right to commercialize, although without any exclusivity. An item for discussion will be the extent to which the company retains any rights to sublicense, but best is to limit these rights as much as possible.

Though the ownership rights provides the university with a certain decision power, this deal means that the university only receives a non-exclusive access to the IP. This might be sufficient depending on the commercialisation strategy of the university.

If the strategy is to set up a spin-off a risk exists that the company can –through its stronger commercial network- take in the market, once the market been created by the university, sooner than the spin-off can.

If the strategy is to combine the obtained IP with IP of its own and to license this bundle to one or multiple parties, difficulties may arise in the negotiation with the potential licensor as well as with the company. The latter might indeed impose limitations on who the university licenses to.

In both strategies it is essential to be able to integrate the obtained IP with IP of its own. If the IP the university bundles with the acquired IP is sufficiently valuable a de facto exclusivity can be derived as a result of the added value of the university's IP. In such cases the non-exclusive back license to the company does not necessarily pose issues or risks in the commercialisation.

Example 2: Transfer full ownership and commercialisation rights to the university free of charge but allow the industrial partner to receive a share of the potential net benefits achieved by the university (net benefit meaning after deducting the patenting and commercialisation costs incurred by the university). Benefits could be shares in a spin-off or license fees and royalties. This was the approach taken with the FOXHES case.

The advantage of this option is that the actual value of the IP at the moment of transfer is acknowledged to be very low, on the other hand the potential value is still recognised and a fair return can be negotiated balancing the investments of the industrial counterpart prior to the transfer and the investments of the university following the transfer. This option further includes the possibility to work out a deal based on (detailed) parameters, such as the royalty level, the amount of shares in relation to either the whole spin-off company and/or all commercial activities vs. only the shares of the university or the commercial activities already identified or fitting within the companies interests …

3.5 Some final remarks

IUT is a complementary way for universities to valorise their technology, know-how or expertise. It is one of the many tools to fulfil their obligations towards society by which they are partially funded. In that respect, IUT is an add-on to the existing and traditional UII activities originating from the numerous highly valuable scientific results created within the universities independently from industry or upon original request.

It is noted again that once a licensee is found or a spin-off is created (partly) based upon the IP transferred in the IUT the loop is “closed” via a more traditional UII, i.e. the rights to the IP are once more with industry.

IUT can lead to a win-win-win situation; a win for the industry, a win for the university and a win for (local) economic activities. IUT is, however, no plea to keep IP rights alive at any cost. On the contrary, the concept of IUT allows unattended IP or know-how to be picked up, to be matured/incubated and further strengthened, leading to e.g. spin-offs supporting and driving the growth of (local) economic activities.

A final remark relates to the fact that this paper refers to a single case study, and no full blown study of other similar cases and their impact has been done. Within Ghent University no similar deal was encountered in the (recent) past and in that respect the new concept of IUT was discussed.

4 Conclusions and recommendations

This paper discussed a practitioner’s case related to the collaboration between a university and an industrial partner related to metal foam. At a certain moment in time this UII resulted in a situation wherein IP was transferred from the industrial partner to the university. As such the case study was used to introduced and discuss the more general concept of Industry to University Transfer (IUT). The enablers as well as the potential pitfalls of such a concept were discussed. It is argued that an IUT free of charge with a fair share of the upward benefits for the industrial counterpart is the best starting point for negotiations to settle the deal. Availability of incubation funding within the university will help to convince the industrial partner that the university has the means to add value, but the industrial partner must be susceptible to alternative business models. However, universities should only engage in such a process if they can add substantial research value.

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Strategies And Instruments To Enhance Contract Research In Universities: Hands-On Experiences And Best Practices Of Academic Institutions In Attracting Research Projects From Industry Within The "Research Studios Austria" Funding Scheme

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Abstract

Contract research as a university financial resource is steadily gaining in importance, especially as the "third mission" of universities is attracting increasing attention on a political level.

Accordingly, in order to support applied R&D and enhance knowledge transfers from academia to business, the "Research Studios Austria (RSA)" funding scheme was launched in 2008 in Austria and to date has funded 34 research projects, conducted by more than 50 units at university and non-university research institutions. One main requirement for programmeme funding is that within 2 years, projects have to secure contract research finance amounting to 20 % of the total project volume.

A special feature of the RSA programmeme is a unique consulting service that supports academic institutions in their acquisition activities, e.g. by identifying relevant market segments and assessing their potential and attractiveness, and by drawing up individual and focused market development strategies. In addition, an extra budget (€ 10,000 – € 11,500) is available per project for marketing and acquisition activities.

Experience from the programme shows that personal contacts and networks, existing business co-operations, workshops with clients and prototypes suitable for presentation are considered as the most important methods and instruments for obtaining contract research projects with industry.

This paper illustrates the experiences derived from the funded research projects of the RSA programmeme with regard to the acquisition of contract research projects. Furthermore, it presents identified best practices in establishing university-industry interactions in the form of contract research projects.

Keywords

Contract research; university; market development; third mission; acquisition

1 Introduction

External funding sources (from private, as well as public sources) are playing a steadily more important role in financing R&D at public universities, especially as the 'third mission' of universities, i.e. the requirement to engage with industry is gaining increasing attention on a political level.

Against this background, the paper aims to shed additional light on the implementation of the third mission at universities, as it presents various first- hand experiences of researchers from Austrian universities and other (mainly or partly) publicly funded Austrian research organisations obtained while attracting research projects from industry. Furthermore, possible strategies and instruments to enhance contract research at universities are also presented.

The paper does not follow a 'classical' scientific approach, as the presented findings and the given recommendations are based only partly on a related scientific study of third party funding at Austrian universities (Elias & Pöchhacker, 2012). The main findings brought forward in this paper are based on the authors' experiences in providing a specific consulting service within the framework of the national `Research Studios Austria' research funding scheme, which supports the acquisition activities of the academic institutions funded by the programme.

The paper is structured as follows. It begins with a short, literature-based analysis of the external funding of R&D at public universities. There follows an elaboration on the current situation in Austria regarding the third party funding of universities and their R&D activities with an emphasis on the financing of university research by private companies (contract research). The next section portrays the 'Research Studios Austria" research funding scheme and is followed by the experiences of the funded researchers in attracting research projects from industry. In addition, some related findings from a corresponding study (Elias & Pöchhacker, 2012) regarding the attraction of third party funded projects are presented. The last section describes the resultant implications for the enhancement of contract research. A conclusion ends the paper.

2 The external funding of R&D at public universities

During the last two decades, the financing structure of university research in many OECD countries has changed in two ways. Firstly, external funding sources are playing an ever-greater role in the conduct of R&D at universities. Secondly, a sharper focus on the effectiveness of public funds is to be observed. Within this context, the competitive funding of research projects and the attraction of contract research from industry are of growing importance to the funding of academic research (Jongbloed et al. 2010, Niederl et al. 2011).

In addition, during the past ten years the “third mission” of universities, i.e. the need for universities to engage with the ‘external’ world and in particular with the economy (parallel to the other two missions of universities: education and research) has attracted increased attention on a political level, as reflected by various strategic documents (for example the ‘Modernisation Agenda’ of the European Commission and the Austrian federal government’s research, technology and innovation strategy).

The global funding of universities still far outweighs that from third parties. However, the share of third party funds (from private as well as public sources) in the financing of universities has increased markedly, as a study conducted on behalf of the European Commission (CHEPS, Institute of Education/University of London & technopolis, 2008) has shown. In 2008, on average public universities received 21% of their revenues through third party funding, while in 1995, third party funding of public universities amounted to roughly 15%.

	1995 (N=26)	**2008 (N=32)**
Operational **grants**	78 %	67 %
Tuition fees	8 %	12 %
Third party **funds**	15 %	21 %

Tab. 1: Average percentages of the main sources of public university revenues, 1995 and 2008

3 University funding in Austria

In Austria, public institutional funding remains the cornerstone of public university financing. Institutional funding to universities is based on three-year performance contracts between the respective university and the Austrian Ministry of Science and Research (BMWF). This funding amounts to approximately 82 % of annual university revenues (total university revenues in 2010: € 3.2bn).

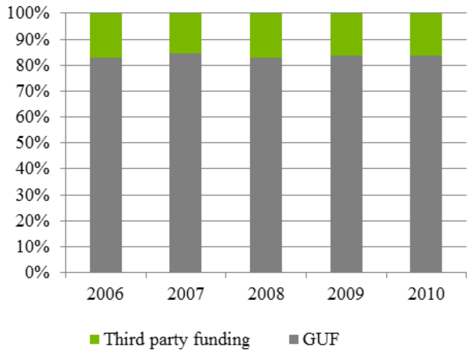

Fig. 1: Total university revenue mix in Austria (2006-2010, in %) (Source: uni:data)

If one considers the financial mix of Austrian universities in the years 2006-2010, an increase in both the global budget (general university funds, GUF) and third party funds is apparent. The global budget accounted for € 2.7bn in 2010, whereas it contributed € 1.8bn in 2006, which represented an increase of about 52%. During the same period, third party funds rose from € 363.5m to € 524.9m, or approximately 44.4%. Moreover, the year-on-year growth of third party funds fell from 15.5 % in 2008 to 4.7% in 2009 and grew only slightly to 6.9 % in 2010. Third party funding in 2011 amounted to € 548.9m, reflecting modest year-on-year growth of roughly 4.5%.

A detailed analysis of total third party university funding and its composition shows that over the years, the share of moneys generated through research projects funded by private companies (contract research) remains below the 25% level, with 25.7% as an outlier.

Fig. 2: Sources of third party funds in % (Source: uni:data)

Unsurprisingly, the share of third party funds generated by contract research differs from university to university. When considering the share of third party funding generated by companies per university, it becomes obvious that technical and medical universities obtain the largest shares of contract research money.

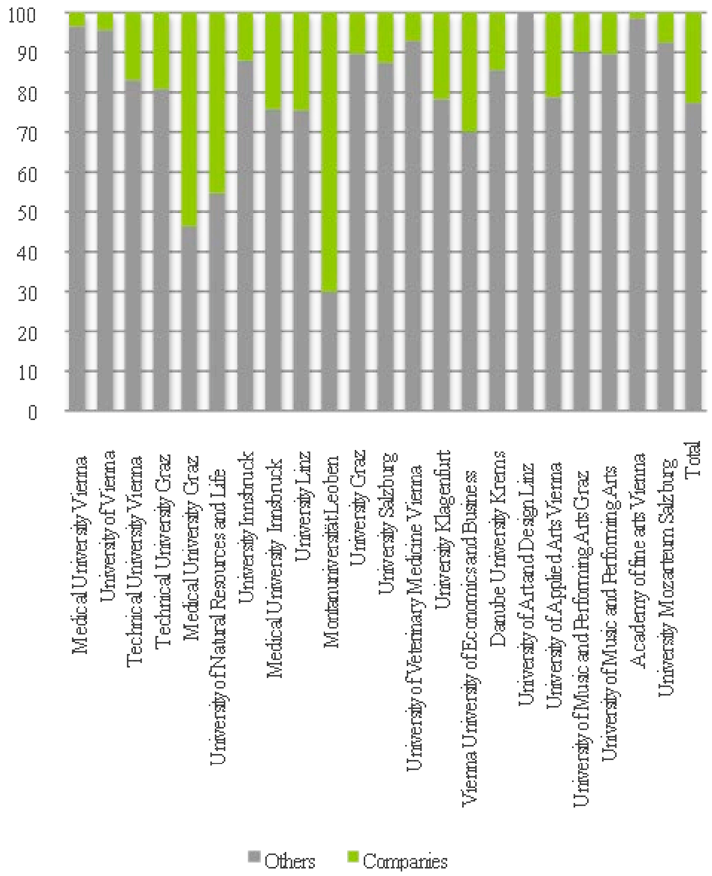

Fig. 3: Sources of third party funds in 2011 in % per university (Source: uni:data)

Against this background, the ‘third mission’ of universities, as well as the encouragement of academia to generate more money through research projects with industry, or on its behalf, has constituted an important issue on the political agenda in Austria in recent years.

4 The “Research Studios Austria” funding scheme

In order to accelerate the innovation process in Austria in general, support applied R&D and enhance the transfer of knowledge from academia to business, in 2008 Austria launched the “Research Studios Austria (RSA)” research funding scheme. The Austrian Ministry of Technology, Family and Youth (BMWFJ) is sponsoring the programme and the Austrian research promotion agency, FFG, is responsible for its implementation.

The RSA programme target groups consist of universities and other (mainly) publicly funded research organizations. The funded projects (labelled ‘Research Studios’) have an average project volume of € 0.94m and the average funding volume per project is about € 0.65m[1]. All projects are of 3-year duration.

The RSA programme is characterized by some specific features that differentiate it from other funding schemes:

- After two years, each Research Studio has (1) to secure contract research finance amounting to 20% of the total project volume *or* (2) implement a spin-off with an Austrian business partner (the business partner has to bring in contributions amounting to at least 20% of the total project volume into the spin-off).
- A specific consulting service supports the academic institutions in their market development activities, e.g. by identifying relevant market segments, assessing their potential and attractiveness, and developing individual and focused market development strategies[2].
- An extra budget (€ 10,000 – € 11,500; depending on the respective funding calls) is available per project for marketing and acquisition instruments.

The RSA programme thus encourages researchers to become actively involved in finding business partners, developing R&D collaborations with business and bringing their ideas to market. This is also supported by the application procedure of the RSA programme, as the applications for funding have to include a concept regarding the economic realization of the respective project's research content.

Each project funded within the RSA programme runs for three years. However, the third and last funding instalment (for the third year) depends on the achievement of the aforementioned targets (securing contract research money amounting to 20% or creation of a spin-off) for each project.

There are no thematic restrictions within the programmeme. Nevertheless, a certain part of the funding volume must be directed towards a contemporary topic (e.g. energy technology).

To date, two RSA programme calls and a `mini-call' have been implemented, and 34 research projects, conducted by more than 50 units/institutes at university and non-university research institutions have been funded within the scheme. From the first initiated call (2008-2011), 13 out of 14 projects succeeded in accomplishing the tasks for the third funding year, which meant that they found business partners for contractual research. Within the current second call (2011-2014), 20 projects are receiving funding. The total funding for the second call amounts to € 12.9m.

[1] Data is based on the project volumes and funding volumes of the funded projects within the second call of the RSA funding scheme.

[2] The authors of this paper provide these specific consulting services.

5 Experience regarding the attraction of contract research projects within the RSA programme

The following findings are based on the authors' experiences in providing the aforementioned consulting service (labelled 'innovation service') within the framework of the RSA programme , which supports the Research Studios (= the funded projects) in their market development activities. The experiences of the funded researchers, as reported to the authors, form an integral part of these findings.

5.1 Status quo regarding market development activites

The starting point of the innovation service was an enquiry regarding already implemented market development activities and the specific demands and needs of researchers in view of their acquisition activities aimed at securing research funding from the business sector.

The funded researchers reported that in particular previously implemented or used customer acquisition activities/instruments included acting as a speaker at scientific conferences, using personal contacts in a systematic manner and attending events for the purpose of contacting customers. The responses of the Research Studios within the second call of the RSA programme are shown in Figure 4. It should be noted, that all but two of the funded projects within the second call are located at public universities, universities of applied sciences or other mainly publicly funded research organizations. The other two research projects are located at a (partly publicly funded) non-profit-making company and an academic spin-off.

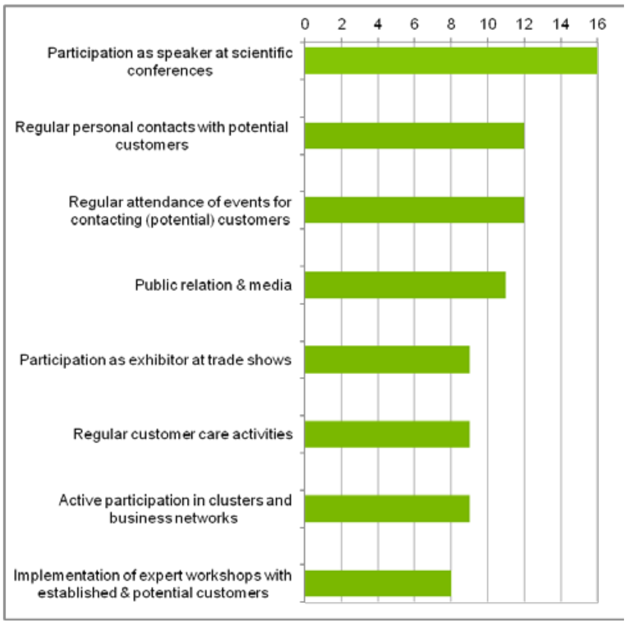

Fig. 4: Implemented customer acquisition and customer care activities

The Research Studios (respectively the Research Studio researchers) were also asked about their specific needs during the acquisition of contract research projects. The main requirements reported were as follows:

- The strategic planning of market development/market cultivation and marketing activities
- The analysis of markets and market segments
- The improvement of market intelligence
- The screening of potential customers, as well as marketing und communications in general.

This is important, as with the exception of the last item these activities are of a strategic nature and represent a key factor for long-term success in the market. It is important to note that the reported needs are partly directed at basic business studies issues. However, it would appear that for many researchers these matters are to a certain extent new (as they have no practical experience in this field), or they have no time to undertake such strategic activities in an in-depth manner.

5.2 The innovation service

As already mentioned, a specific consulting service within the framework of the RSA programme supports the Research Studios in their acquisition activities. This specific consulting service bears the label ‘innovation service’ and is provided by Pöchhacker Innovation Consulting. In addition, each funded project possesses an extra budget (€ 10,000 – € 11,500; depending on the respective funding calls) for marketing and acquisition instruments (activities and operating expenditure). The innovation service also includes the organization and implementation of joint events and further training for the Research Studios. Further trainings included:

- Market analysis – market positioning – market development (training sessions)
- ‘Connecting research and markets’ – the successful use of networks
- The commercialization of research findings

Experts on these issues are organized and various small sessions arranged for the discussion of individual requests.

The individual assistance to each Research Studio forms an integral part of the innovation service. Each institute may use the innovation service for 4-5 consulting days. Individual assistance includes the performance of specific tasks on behalf of, or together with, the funded project and/or the obtaining of specific experts.

The activities and instruments furnished by the innovation service relate to the reported needs of the Research Studios and can be grouped into three broad categories:

5.2.1 Market intelligence

Instruments that assist the Research Studios in obtaining an overview of their relevant market(s) and for which assistance is provided, include:

- Market analysis and market observation, e.g. through workshops for the definition of relevant competitors, substitute products and technologies, or the screening of relevant, potential customers.
- Market segmentation, e.g. through workshops to define relevant market segments and the development of specific strategies for their approach.
- Defining the attractiveness of markets, e.g. by assessing the attractiveness of certain market segments and the lead over other competitors.
- Market positioning, e.g. by developing strategies for market positioning based on the aforementioned activities (market analysis, market attractiveness, etc.).
- Customer databases, e.g. by providing experts for the establishment of a suitable customer database.

5.2.2 Sales approach & customer care

Instruments, that assist the Research Studios in their sales approach and their customer care activities and for which assistance is provided, include:

- Personal contacts, e.g. developing strategies jointly for the systemic use of personal contacts to attract research projects.
- Customer workshops, e.g. designing customer workshops (together) or assisting in their organization.
- Using various networks, e.g. by developing roadmaps for the use in (institutional as well as non-institutional) networks and clusters.

5.2.3 Marketing & Communications

Instruments that help the Research Studios in their marketing and communication activities and through which assistance is provided, or where appropriate experts are obtained, include:

- The holding of workshops and events
- Visiting trade shows and symposia
- Various information activities (websites, folders, business references, etc.)

To date, the Research Studios have made particular use of the various strategic activities relating to market overviews and the planning of market development activities. These activities form the basis for wider market acquisition drives by many Research Studios.

The aforementioned extra budget for marketing and acquisition activities is used mainly for diverse promotional items (e.g. websites, information folders or promotional films), for travelling to non-academic conferences and events (e.g. trade shows or fairs) and for the organization of events and conferences.

5.3 Experiences of the RSA programme partners with regard to attracting research projects from industry

During a number of meetings, the Research Studios (respectively the funded researchers) from the RSA programme were asked to reflect upon their experiences in connection with the attraction of research projects from industry as part of the implementation of their projects and what, based on this actual experience, they considered to be vital or inhibiting factors in acquiring contract research projects.

The Research Studios named the following as vital factors and activities in attracting research projects from industry:

› Existing personal contacts and relationships, as well as personal networks, are seen as crucial instruments for attracting research projects. Unsurprisingly, personal contacts established during cooperative projects, attendance at events and most importantly, with graduates from the same university/institute who work for potential customers, would appear to be the key factors for attracting research projects from industry.

› Existing business co-operations, e.g. based on previous research projects with companies, which often result in personal relationships, facilitate the attraction of contract research projects.

› The Research Studios also reported that customer workshops, which constitute a specific care instrument for the discussion of the specific needs of potential customers and possible solutions, constitute a successful instrument.

› Systematic and well-prepared attendance at trade shows is considered to be an effective approach to the commercial exploitation of research output.

› Prototypes suitable for presentation or a full-cover, high-quality portfolio of reference projects would also seem to be vital to customer acquisition.

› Some projects reported that specific cooperation platforms facilitate matching with partners from industry.

› The organization of and attendance at symposiums are also considered helpful.

According to the reported experiences of the Research Studios, inhibitive factors relating to the attraction of research projects from industry include the following:

- › Market entry within two or three years proves to be difficult (a requirement of the RSA programme is that contract research projects amounting to 20% of the total project volume have to be secured after two years) for project-developed 'advanced' and 'forward looking' products, technologies or services. In addition, some of these products, technologies or services may well be of interest to potential customers in the future, but can conflict with their immediate requirements.
- › Cost pressure (as demanded by industry). In general, the projects offer new and advanced technologies that are also expensive (owing to development costs). On the other hand, for companies the practicality of these new solutions is often unproven and therefore they frequently only order a prototype. Accordingly, order volumes are generally too low for the use of economies of scale.
- › It sometimes happens that previous projects, which could serve as important references, cannot be employed owing to intellectual property rights or non-disclosure agreements.
- › A number of Research Studios reported that detecting and obtaining the 'right' contacts (decision makers within a company) appears to be a difficult task.

5.4 Main Strategies and Instruments

The **authors' experiences in providing the 'innovation service' within the framework of the RSA programme and in particular the experiences reported, show that** personal contacts and networks, as well as existing business co-operations furnish a certain degree of mutual trust between the project and potential customers and are therefore regarded as crucial to obtaining contract research projects from industry. Consumer workshops with potential clients that help to establish a basis for personal relationships and mutual trust are also considered to be a successful method of acquiring contract research. For some of the Research Studios, potential market segments or customers are more or less identical with their core competences; therefore respective personal networks exist and can be exploited.

Some Research Studios wish to use their product, technology or service in (for them) new or unexplored markets. In such cases, relevant personal contacts or business co-operations rarely exist. Projects are therefore confronted with a 'cold calling' process and consequently, for these projects in particular, the various strategic activities relating to market overview and the planning of market development activities are crucial, as they provide a platform for further market acquisition measures. Consumer workshops with potential clients can also be of importance for these projects. However, the key instruments in attracting contract research projects from industry consist of prototypes suitable for presentation or a high-quality portfolio of reference projects, which underline the competences of the Research Studios.

6 More findings regarding promotional and inhibiting factors affecting university-industry collaboration

A recent study by the authors (Elias & Pöchhacker, 2012) on the third party funding of R&D in Austrian universities, identifies promotional and inhibiting factors affecting the attraction of third party funding in general, as well as relevant best practice. The study uses a qualitative approach and examines a number of Austrian universities in some detail. As these findings complement the experiences gathered during the RSA programme, they are presented in the following paragraphs.

Examples of factors promoting or enhancing (the raising of) third party funding for R&E at universities include support services at universities, national or regional funding agencies and intermediates. In Austria, cooperative research funding programmes form a substantial basis for collaboration with companies.

In addition, R&D collaboration with industry often results in personal incentives for research (e.g. receipt of personal benefits or bonuses, premiums for inventions, attendance expenses for conferences, etc.) and in turn, can lead to greater involvement in contractual research. Moreover, third party funded research projects contribute to profile building and the establishing of priorities by Austrian universities in relation to their R&D activities.

First and foremost, the inhibiting factors influencing the attainment of third party funded R&D projects consist of the administrative load, which may discourage academics from engaging in contractual research. This is especially true of large- scale projects that require extensive preliminary work and risk management, and therefore often result in sizeable project-related managerial and administrative burdens. In addition, conflicts connected to the exploitation of individual property rights, particularly within cooperative research projects with companies are common, and therefore clearly another deterrent to contractual research. Finally, a shortage of investment in (up-to-date) research facilities, which would allow universities to be competitive in obtaining third party funded projects in the long-term, is also perceived as an inhibiting factor.

Best practices already implemented at Austrian universities, which address these promotional and inhibiting factors and are aimed at supporting university-industry collaboration, include:

- The establishment of “one-stop shops” at universities for university researchers, which deal with all aspects of third party funded research projects.

- The internal, front-end financing of highly lucrative and strategically important projects, and internal start-up financing for contract research projects.
- Monetary incentives for researchers based on performance criteria (e.g. including the raising of third party funds).
- Teaching sabbaticals in order to allow the completion (and securing) of large-scale research projects.
- The integration into the training of junior scientific staff of basic information on third party funding and contract research.
- A continuous flow of current information to the R&D staff (e.g. using social media such as twitter) on research funding programmes, respective calls, interested companies, information events, etc.
- Framework agreements with the umbrella organizations in specific industrial sectors concerning IPR in research co-operations.

7 Conclusions

We have shed some additional light on the implementation of the third mission in universities through the presentation of various first-hand experiences acquired by researchers from Austrian universities and other (mainly or partly) publicly funded Austrian research organisations during the attraction of research projects from industry.

The main findings of this paper are based on our experiences in supporting academic institutions that are funded within the 'Research Studios Austria' programme during their market development and acquisition activities aimed at attracting contract research from industry. A number of instruments are used by the Research Studios in this regard, e.g. market intelligence instruments to ensure a strategic approach to market development, or instruments in the marketing and information area.

Two main strategic approaches to the acquisition of contract research projects from industry are highlighted. The first focuses on the use of personal networks and contacts (where possible) and the second on the reliance upon strategic planning for the 'cold calling' process.

It is mentioned several times that personal contacts are crucial to the acquisition of contract research projects from industry, a finding that is in line with the relevant literature (see, e.g. Davey et al., 2011). A deduction from this finding is that if personal contacts or networks are lacking (as the researchers approach new or unexplored markets), the researchers should be supported in establishing such contacts and relationships, e.g. by co-operative research projects, joint workshops or attendance at relevant events and fairs.

In order to ensure the implementation of the ‘third mission’ of the universities, university researchers require some specific assistance. Firstly, an awareness of the importance of the third mission of universities has to be heightened (or rekindled) in their mindset. Secondly, researchers should be enabled to acquire specific (basic) competences in the area of market development, e.g. by attending related workshops offered by the universities. Thirdly, they should be provided with specific support structures and resources regarding their market development and acquisition activities, e.g. (non-academic) personnel employed partly to assist the market development process.

The adequate support of university researchers in their main activities comprised by education, research and involvement with business (third mission), as well as the establishment of relevant framework conditions (e.g. minimization of the administrative burden on researchers) will thus continue to be key factors in the fostering of university-industry collaborations and the enhancement of contract research at universities.

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University Brainpower Unchained: A Comparative Analysis Of University-Business Cooperation in the US and Finland

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Abstract
This paper presents a comparative analysis of university-business cooperation (UBC) in the US and Finland, drawing on the experience of three US universities (Massachusetts Institute of Technology, University of Utah and University of Colorado at Boulder) and four Finnish universities (Aalto University, University of Jyväskylä, University of Turku, and Lappeenranta University of Technology). The analysis is conducted along three major axes of the UBC process: (i) institutional context (UBC origins, stakeholders and financial resources); (ii) process (drivers, barriers, motivations and objectives); and (iii) results (benefits and impact on stakeholders). By focusing on the inner workings of the UBC process in seven universities that are among the leaders in this area in their respective countries and also in the world, the paper provides insights and recommendations for other universities in Finland and elsewhere that are at earlier stages in the development of this process and seek inspiration from good practice in more advanced universities. Our approach is all the more relevant as UBC and academic entrepreneurship have become top priorities on the innovation policy and management agenda, and have a high potential to inform and add value to academic researchers' portfolio, help realise the creative talent of students, create jobs and revenues for the local economies and turn them into vibrant innovative environments.

Keywords
Entrepreneurial university, university-business cooperation, entrepreneurship education and research, technology transfer, start-ups, academic 'third mission'

1 Introduction

Relationships In the transition from the Industrial to the Knowledge Society, universities have emerged as key players in innovation and regional and national economic development - a 'third mission' that was added to the traditional university missions of education and research. New activities, such as commercialisation of academic research results and interaction with business partners, but also more broadly with cultural, not-for-profit and civil society organizations, responsiveness to societal concerns, interdisciplinary research spanning from engineering and medicine to social sciences and the arts, and new forms of student experiential learning and involvement in entrepreneurial activities have been added to the university remit. University-business cooperation

(UBC) no longer takes place across discrete boundaries, but the boundaries themselves have been blurred by the creation of new hybrid entities that operate under new organizational dynamics.

Commercialisation of university research has a long presence in US universities, and has been encouraged by a variety of federal, state and non-governmental initiatives. At the same time, an important bottom-up effort for developing UBC has been in place, rooted in a long tradition of service to the community that emerged from the land grant universities and the Morrill Act of 1862, which contributed to shaping the frequency and form of relationships with business. Federal government intervention has been present for over six decades, from the post-WWII emphasis on building up the R&D capabilities of national labs, universities and corporate research centres through government-oriented missions as defence, energy, space exploration, health, and agriculture, to several initiatives in the subsequent decades that marked a shift from a non-interventionist role to an increasingly interventionist role ('hidden interventionist policy') at regional and federal level (Etzkowitz and Kemelgor, 1998). The 1960s focus on technology transfer aimed to promote greater civilian 'spin-offs' from mission-driven public R&D (Shapira, 1991) was followed in the 1970s by the Domestic Policy Review (DPR) of Industrial Innovation undertaken by the Carter administration under the pressure of the economic productivity decline of that time (Alic, 2001). The DPR set the stage for most of the subsequent shifts in US technology policy that followed a decade or so later, by encouraging easier licensing of federally-owned patents, closer ties between universities and industry, help for entrepreneurial firms through small business innovation funds, safeguarding cooperative R&D, and tax incentives for R&D. In the late 1980s and the 1990s, the main instruments of the 'hidden interventionist policy', i.e. the federal funding of universities and the IPR regime promoted by the 1980 Bayh-Dole Act and the Stevenson-Wydler law, did not create direct links between academic institutions and companies, but provided the financial incentives for such collaborations within the research funding system, as academic entrepreneurial capacities became essential criteria for federal funding (Etzkowitz and Kemelgor, 1998). Also, the creation of technology centres in universities stimulated the use of academic knowledge for product development and the participation of industry representatives in the academic research agenda-setting. In industry, these measures enhanced interest in external sources of knowledge, strategic alliances with other companies and contracting out, participation in academic projects and technology centres to access new technologies, cost sharing and consulting arrangements for particular research areas involving academics.

More direct forms of interventionist policy of the US federal government, particularly in the civilian arena, emerged in the post-Cold War period, when the Clinton administration promoted international economic competition and an open industrial policy, largely based on reconversion of former military capacities, including R&D capacities, to civilian purposes. Many elements of the open policy were met with scepticism, as they were seen as a 'picking winners' approach. They paved the way toward a mixed economy that combined market policies with more centralised ones. Many of the initiatives and policies of the former 'hidden government policy', such as technology centres and technology transfer offices, continued to co-exist with newer forms of the open policy, with some changes that could be observed, e.g. in the funding mechanisms for technology centres and national laboratories. Some of the most relevant initiatives of the open, more direct industrial policy, such as the *Advanced Technology Program (ATP), the Small Business Innovation Research Program (SBIR),* the 'dual use' concept and the *Technology Reinvestment Program (TRP)* led by the Defence Advanced Research Projects Agency (DARPA) aimed at creating networks of innovation across academia, industry and government, using concepts such as 'bottom-up planning mechanisms', 'decentralised centralisation' or 'policy trajectories' within a number of specific programmes. More recent initiatives, like the *America Invents Act,* signed in 2011 by President Obama, with the aim to "help American entrepreneurs and businesses bring their inventions to market sooner, creating new businesses and new jobs" (The White House, 2011), *Start-up America,* an umbrella under which innovators from academia and industry can work in coordination with the government, or *Skills for America's Future,* a government-led effort to build partnerships with industry, labour unions, community colleges and other training providers in all the 50 states for developing the country's workforce through education, are only a few examples of federal government support to UBC.

In addition, an important number of non-governmental initiatives come from organisations like the National Association for Community College Entrepreneurship (NACCE) that acts as a forum for the dissemination and integration of knowledge and successful practices in entrepreneurship education and student business incubation, the Council on Competitiveness that brings together CEOs, university presidents, and labour leaders to address competitiveness challenges, or the Business Higher Education Forum (BHEF), which is an organization of senior business and higher education executives that aim to provide innovative solutions to US education and workforce challenges.

In Europe, the UBC process has started later and was driven by two main factors: on the one hand, national and regional governments' innovation and entrepreneurship policies aimed to improve the institutional framework for public-private partnerships and create framework conditions, support schemes, incentives and regulations for an effective outcome of such partnerships[1]. Although the government support varies greatly across Europe, the general trend has been towards bringing together university and businesses as an eligibility condition for accessing public funding in certain programmes, increasing the direct funding of business R&D and innovation, tax incentives for R&D in enterprises and support for entrepreneurship, regulation of revenues and intellectual property rights, etc. On the other hand, the European Commission's policies for strengthening

[1] See http://ec.europa.eu/education/higher-education/business-examples_en.htm for some examples of successful UBC in Europe.

UBC as part of the Knowledge Triangle[2] of education, research and innovation have played an important role. For example, the *Innovation Union* flagship initiative of the *Europe 2020* strategy contains over thirty action points for strengthening education, research and innovation, including groundbreaking proposals like the European Innovation Partnerships, promoting the European Institute of Innovation and Technology (EIT) as a model of innovation governance in Europe, creating a single innovation market, etc[3]. Other major initiatives include the *European Union Business Forum*[4], established in 2008 as a dialogue platform to facilitate exchange of experience and good practice among relevant stakeholders, to support mutual learning and inspire relevant reforms, the *Knowledge Alliances*[5] launched as a pilot action in 2011 to develop structured, result-driven cooperation ventures between universities and companies, the *Knowledge and Innovation Communities (KICs)* that bring together industry, higher education and research in relevant areas of societal challenges, under the coordination of the European Institute of Technology, *European industrial doctorates and doctoral schools* to foster innovation in research, etc.

Finland has benefited from a highly subsidised and government-financed university system, but this fairy tale is about to change, as the euro crisis, budget deficits and cuts, as well as inefficiency in the administration of available resources have brought about the need for paying more attention to the universities' "third mission". A landmark point in the evolution of UBC in Finland is the Universities Act of 2009, which came into effect at the beginning of 2010 and introduced a new era for the Finnish universities by allowing them to become independent legal entities, giving them more freedom in the management of their finances and overall autonomy and responsibility. In other words, the Act required Finnish universities to think and act more like entrepreneurial organizations, increase the scope and intensity of actions needed to better synergise with, and get financing from, private companies and organizations, in addition to the state funding. Before 2009, UBC was based on such elements as ad hoc projects, typically focused on data collection for research purposes, business guest speakers during lectures, etc., or ties with local business communities in some universities. Government competitive funding channelled through institutions such as the Finnish Innovation Agency TEKES and the Academy of Finland already had dominant roles. Becoming entrepreneurial is nowadays a necessity, not an option for Finnish universities, especially for the smaller universities that compete for resources with the larger ones and see entrepreneurialism as a strategy for survival.

The journey to becoming an entrepreneurial university in Finland is not, however, an easy one. Even if the idea of commercializing R&D is accepted especially amongst the

[2] The Knowledge Triangle is a central theme of the Lisbon Strategy and refers to the integration of education, research and innovation as key drivers of the Knowledge Society.

[3] See the complete list of action points at http://ec.europa.eu/research/innovation-union/index_en.cfm?pg=action-points

[4] http://ec.europa.eu/education/higher-education/business_en.htm

[5] http://ec.europa.eu/education/higher-education/knowledge_en.htm

younger generations, the vision of research serving business purposes is still seen by some as ‘revolutionary’ and there are still many fears and doubts hovering around the concept of UBC. An underlying perception of a conflict of interest between research, teaching and the ‘third mission’ is still present in many universities, and the incentives for faculty to embark on entrepreneurial endeavours are currently insufficient. Also, companies are not used to paying for services provided by universities, since the field of education is highly subsidised in Finland. In addition, the Nordic welfare model, which has well served to building up one of the best functioning modern societies, does not encourage enough for individual risk-taking, but values instead collective success and equality principles. This is especially true when comparing to the US, where institutional champions and individual efforts are always emphasised, as part of a more individualistic culture that usually suppresses the contributions of collaborators and pushes a single individual to the forefront.

This paper presents a comparative analysis of UBC in the US and Finland, drawing on the experience of three US universities (MIT, University of Utah and University of Colorado at Boulder) and four Finnish universities (Aalto University, University of Jyväskylä, University of Turku, and Lappeenranta University of Technology). By focusing on the inner workings of the UBC process in seven universities that are among the leaders in this area in their respective countries and also in the world, the paper aims to provide insights and recommendations for other universities in Finland and elsewhere that are at earlier stages in the development of this process, and inform UBC policy-making and practice. Our approach is all the more relevant as UBC and academic entrepreneurship have become top priorities on the innovation policy and management agenda, and have a high potential to inform and add value to academic researchers’ efforts, help realise the creative talent of students, create jobs and revenues for the local economies and turn them into vibrant innovative environments.

The remainder of the paper is structured as follows: Section 1 sets out the theoretical framework for the analysis of UBC. Section 2 introduces the seven US and Finnish case studies and discusses some methodological issues that provide the grounds for the selection of the case studies and the structure of the analysis. Section 3 presents the findings derived from the analysis of the seven case studies, structured along three dimensions: institutional context, process and impact of UBC. Finally, section 4 provides the concluding remarks and a number of recommendations stemming from the analysis of the case studies.

2 Theoretical framework

UBC has gained increasing recognition as a complex phenomenon in the dynamics of academic and business communities over the last three decades or so, and became a priority on the innovation policy and management agenda. A significant body of UBC theoretical and empirical research has grown from contributions from all over the world, providing a general framework for exploring UBC features and dynamics, and for informing national, regional and international innovation and development policy-making[6].

The theoretical framework describing UBC encompasses several literature streams, which reflects the complexity of the topic and the various perspectives from which it can be addressed. Among them, the National Innovation Systems (NIS) model (Freeman, 1987, 1988; Freeman and Lundvall 1988; Dosi et al 1988; Lundvall, 1988; 1992; Nelson, 1993; Nelson and Rosenberg, 1993; Edquist, 1997, 2005), linear and non-linear (networked) innovation models (Kline and Rosenberg, 1986; Dosi et al., 1988 and Malecki, 1997), the exploration-exploitation dichotomy (March, 1991), the "academic capitalism" theory (Slaughter & Rhoades, 2004) and the Triple Helix model (Etzkowitz, 2003, 2008; Etzkowitz and Leydesdorff, 1995, 1998, 2000) acknowledge the role of universities and business firms in the innovation process, but differ in the prominence granted to universities in the innovation process and the attention paid to the level of interaction with business and government.

The Triple Helix model argues that the potential for innovation and economic development in a Knowledge Society lies in a more prominent role for the university and in the hybridisation of elements from university, industry and government to generate new institutional and social formats for the production, transfer and application of knowledge. The model introduces thus a three-dimensional perspective of innovation dynamics at the levels of business, science institutions and governance, and sees innovation as the result of the interplay between differentiation and integration in the industry-academia-government system. In comparison with the other literature streams mentioned above, the Triple Helix model provides a more fine-grained description of the nature of and relationships between innovation actors than the NIS model, and accommodates both institutional and individual roles in innovation through the hybrid organisational formats created at the university-industry-government interface and concepts like the 'innovation organiser' and 'entrepreneurial scientist'. The Triple Helix model also goes beyond the system boundaries defined by national or regional borders, by industry structures or by technologies that typically cross both geographic and sectoral boundaries. Here, sectoral or technology boundaries are less important as long as regional and local resources are combined for realising joint objectives and new institutional formats. The Triple Helix model moves away from the linear innovation model, describing the innovation process as a non-linear process, and goes beyond the negative consequences of the entrepreneurial turn in academia depicted in the "academic capitalism" theory, focusing instead on the benefits of academic performance derived from enhancing entrepreneurial activities (i.e. a "more the more" hypothesis).

[6] See, for example, the VINN Excellence Centres and the VINNVÄXT Programme of the Swedish Governmental Agency for Innovation Systems VINNOVA, or Brazil's 2004 Innovation Law that incentivizes the interaction between firms, public universities and research centres, or the European Union's Europe 2020 Strategy and its Innovation Union flagship initiative.

UBC literature provides rich evidence of various features of the complex nature of UBC, such as:

- **Purpose**: e.g. entrepreneurship education and research, staff and student mobility and internships, cooperative education (Bramwell and Wolfe, 2008), education targeted at company managers and owners (Gordon and Jack, 2010), knowledge transfer activities such as collaboration on patents, teaching, publications, informal exchanges and contribution to spin-off formation (Landry et al., 2010), cooperation in curricula (Bramwell and Wolfe, 2008), research partnerships (Boardman and Ponomariov, 2009), informal interactions (Guerrero and Urbano, 2010), investment in infrastructure (Adams, 2009), involvement of business representatives in university board structures or vice versa (Gibney, Copeland and Murie, 2009);
- **Institutional forms**: some types of interaction depend more on the knowledge needs of the company and the type of knowledge that needs to be transferred, e.g. joint ventures are more effective for the transfer of complex capabilities than contract-based arrangements, such as licensing agreements (Mowery et al. 1996). Other institutional forms include science parks (Monck et al. 1988, Quintas et al., 1992; Massey et al., 1992), spin-offs (Bathelt, Kogler and Munro, 2010), innovation accelerators (Audretsch, Aldridge and Mark, 2011), high technology centres (Smilor, O'Donnell, Stein and Welborn, 2007), technology transfer offices (Clarysse, Tartari and Salter, 2011), interdisciplinary centres and co-operation networks (Guerrero and Urbano, 2010), industrial liaison offices, and interdisciplinary centres and networks (Jones-Evans et al., 1999; Howells et al., 1998; Jensen et al., 2003; Chapple et al., 2005; Markman et al., 2005).
- **Geographic spread**: UBC can be concentrated in a unique physical location, such as research parks, or can be spread over a larger area in the form of regional clusters (Breznitz et al, 2008) or take the form of virtual networks, such as the Virtual Incubation Network launched by the Start-Up America initiative[7].
- **Varying partnership strategy over time**: e.g. from a focus on managing knowledge and establishing strong links with well-established companies in the early years, to a focus on technology and infrastructure management, entrepreneurship and new start-ups, as the collaboration matures (Adams, 2009; Wonglimpiyarat, 2010).
- **Motivations:** such as regional development, which has been progressively integrated in the core mission of universities over the past decades (Goldstein, 2010), or personal motivations for scientists, which refer particularly to the

[7] National Association for Community College and Entrepreneurship, www.nacce.com/

balance between a sense of intrinsic satisfaction and career rewards over financial rewards (Lam, 2010).

- **Benefits:** such as wealth creation for higher education institutions, as well as for the wider economy through start-ups from graduates of entrepreneurship education (Astebro, Bazzazian and Braguinsky, 2012), graduate job creation and job placements (Guerrero, Kirby and Urbano, 2011), social capital and social network creation through educational programmes targeted at owners and managers (Gordon and Jack 2010), or personal benefits for academics, in the sense of entrepreneurial academics acquiring a pre-dominant position vis-à-vis traditional academics (Lam 2010). Also, entrepreneurship education for students helps them combine learning philosophies, explore real-life situations and entrepreneurial behaviours when creating new ventures (Ollila and Williams-Middleton, 2011), and engage into social entrepreneurship (Mars and Rhodes 2012). Learning benefits are important also for companies. UBC allowed more effective implementation of organisational learning and innovation strategies (Ciborra, 1991), facilitated knowledge transfer and enhanced capabilities to deal more effectively with technological and market uncertainty (Hagedoorn et al. 2000). UBC also facilitated adoption of new skills, in particular the collective and people-embedded tacit ones (Doz and Hamel, 1998) and enhanced learning from each other's experience, supported trust-building by better understanding the R&D needs of industrial manufacturers and market demands, increased contract research funding, recruitment of academic scientists and engineers and adoption of several technical solutions, models and data developed in public laboratories (Gonard, 1999). UBC has also been recognized for increasing competitive advantage (Burgelman 1990; Senge 1990; Prahalad and Hamel 1990; Porter 1980; 1990) and for integrating both learning and R&D into the strategies of corporations (Wright et al. 2004).
- **Drivers*:*** appear to be different for the actors involved:
    - *For business,* UBC has been driven by fierce competition on technology markets and fast transition to knowledge markets, the need to share increasing research risks and costs, and the search for external knowledge, technology, trained human resources and new partners. Much of this search originated in "the decline of technical self-sufficiency" (Fusfeld, 1991), whereby corporate growth strategies based only on in-house technical and knowledge resources or easily affordable within reasonable time and cost were no longer possible, especially since the 1990s. The openness to collaborative research has no longer been considered a company weakness and became an important form of learning, marking one of the most significant changes of corporate management attitude.

- *For the university*, two UBC drivers are particularly important. First, the "new funding rationale of university research" (Geuna, 1999) emerging in the 1990s and consisting of a declining, or constant overall government funding for university research, forcing universities to rely increasingly on other, non-governmental funding sources, such as firms and foundations. The new funding rationale also brought about a changing allocation of public funding flows, with increasing competitive funding and declining institutional one. This determined an increased need for accessing industrial funds and for finding an exploitation outlet for research capabilities and accessing complementary expertise, state-of-the-art equipment and facilities (Howells et al. 1998). Secondly, academics' attitude towards collaboration with industry has changed gradually, slowly moving out of a classical, pre-modern stance into a modern one, similar to that adopted long before by industrial companies (Hill, 1995) and reflecting a changing social division of labour between universities and industry, with university complementing the existing knowledge in the partner firm, stimulating productivity and technological opportunities and accelerating new product development (Lee, 1996). Three factors appeared to be instrumental in generating this change: (i) external pressures exerted on universities by outside institutions, especially government; (ii) changes in the higher education system, such as resource dependence and 'institutional isomorphism'; and (iii) natural evolution, in which academics hope to capture profits that are unattainable under the old arrangements (Feller, 1990). Internal changes within academia ultimately led to a "normative change in science" (Etzkowitz, 1998) and a spontaneous growth of UBC, although institutional transfer mechanisms had a limited role in this process (Sanchez and Tejedor, 1995).

› **Barriers to UBC** can be organisational, financial, and political (Guerrero, Kirby, and Urbano 2011). The absence of an entrepreneurial culture within the university, of incentives for faculty entrepreneurship and entrepreneurship education and programmes can damage UBC (Phillpott et al. 2011). Also, the lack of resources and capabilities diminishes UBC initiatives (Rasmussen and Borch 2010; Turk-Bicakci and Brint 2005). Another barrier is the academics' fear of potential threats to academic values arising from university patenting, losing control over the research direction, publication delays and refusal to share research results upon request (Florida and Cohen, 1999; Blumenthal et al. 1997).

These features suggest that UBC has grown into an increasingly complex phenomenon, which has specific aspects from one country to another, but also certain similarities across some countries or world regions that need to be further explored, especially through comparative analyses. This paper provides such a comparative analysis and takes a closer look at some UBC features in the US and Finland - two countries, cultures and innovation ecosystems that share significant similarities, but also significant differences.

3 Methodological issues

3.1 The case studies

The paper examines the innovation and entrepreneurship ecosystems at three US and four Finnish universities, as follows:

› **Massachusetts Institute of Technology (MIT)**

MIT is one of the world leaders in research collaboration with business and other leading research institutions, and also one of the pioneers of entrepreneurship teaching, research and practice, based upon technological innovation. As one of the first land-grant colleges, MIT had a strong focus on practical rather than classical education, as reflected by its emphasis on '*mens et manus' (*mind and hand) that characterizes its entrepreneurship curriculum and programming, introduced as early as the 1960s. Three elements of MIT's entrepreneurial ecosystem are addressed in this study: the *Martin Trust Centre for MIT Entrepreneurship* at Sloan School of Management, the *Deshpande Centre for Technological Innovation* at the School of Engineering and the *MIT Technology Licensing Office*. The *Martin Trust Centre for MIT Entrepreneurship* coordinates MIT's entrepreneurial activities and interests and develops future entrepreneurs through education, research and strategic business and technology partnerships. The Centre also works to create a network that unifies academic, government, and industry leaders around the vision of entrepreneurial success. The *Deshpande Centre* has the mission to move technology and inventions from the MIT labs to the marketplace, by promoting the earliest stages of technology development with grant funding, connecting MIT's inventors with the business community (particularly in New England) and tying MIT's technological research into market needs. It supports a wide range of emerging technologies including biotechnology, biomedical devices, information technology, new materials, tiny tech, and energy innovations. The *Technology Licensing Office* fosters commercial investment in the inventions and discoveries flowing from the research at the MIT and Lincoln Laboratory (a federally-funded R&D centre that applies advanced technology to problems of national security), through licensing of the intellectual property resulting from the research. All these three centres work closely with other three centres of MIT's entrepreneurial ecosystem: Legatum Centre, which focuses on social entrepreneurship among MIT students, Lemelson-MIT, which promotes invention at MIT, in particular among students, and the

Venture Mentoring Service, which matches student, faculty, staff and alumni entrepreneurs with mentors.

› **University of Utah**

The research focus is on the lead actors in technology commercialization, partnerships with the community, student innovation and entrepreneurship education: the *Technology Venture Development Office (Tech Ventures)* and its departments: the *Technology Commercialization Office*, which manages the university's intellectual property, and the *Pierre Lassonde Entrepreneur Centre*, which provides business and entrepreneurship education to students and young entrepreneurs. Tech Ventures was created in 2005, when the university reorganized the commercialization of industry-sponsored research in view of performing this activity more systematically across the campus and meeting the needs of the entrepreneurial faculty who was asking for better support from the university in initiating or advancing start-up activities. Tech Ventures works closely with the David Eccles School of Business, which provides a complete range of business education with strong emphasis on technology, innovation, commercialization and entrepreneurship, and some of the Schools' Knowledge Centres, like the Bureau for Economic and Business Research and the Sorensen Centre for Discovery and Innovation. Tech Ventures also works with the School's University Venture Fund and its affiliate, the University Impact Fund. Also part of the university's entrepreneurial ecosystem is the Research Park, which houses companies and academic departments and provides a fertile environment for entrepreneurial growth through practical research and business opportunities for faculty and students.

University of Utah holds a remarkable record: it ranked no. 1 in the US in starting companies based on university research for three consecutive years - 2009, 2010 and 2011, according to the annual surveys of the Association of University Technology Managers (AUTM). This designation places the university ahead of technology powerhouses like MIT, Columbia, Caltech and Johns Hopkins (Sutherland, 2012). Launched in an impressive number of over 220 since 1970, they emerged at a rate nearly 10 times higher in the years since the 2005 inception of Tech Ventures (144 start-ups during 2006-2012, average 20.8 per year) than in the 1970-2005 period (79 start-ups, average 2.2 per year) (Brittain 2012). A record number of 22 start-ups were created in 2009, five times the national average of four start-up companies created by US research universities (Crispin, 2011). This performance in creating start-ups is even more significant when considering the University of Utah's research spending compared to other top universities, e.g. $450 M on research in 2010, compared to $1.4 B at MIT (Technology Venture Development, 2011). Key to this achievement is the university's vision of reinventing the commercialization of university research based on the concept of "total mission integration", seamlessly combining excellent education and research performance of faculty and students with a strong and more permissive culture of entrepreneurship and innovation and a unique vision of the university to bring technology to the local community, create jobs and grow Utah's reputation as an innovation hub.

› **Colorado University at Boulder**

Colorado University (CU) at Boulder has a set of "confederated centres of entrepreneurship" that work in synergy to realize the university policy goal of turning CU into a leading entrepreneurial university: the Deming Centre for Entrepreneurship, the Management and Entrepreneurship Division and the Centre for Education on Social Responsibility in the Leeds Business School, the Entrepreneurship Centre for Music, the campus-wide Alliance for Technology, Learning and Society (ATLAS), the College of Engineering and Applied Sciences with its Engineering Entrepreneurship Program (E-ship), the CU Technology Transfer Office, the Centre for Space Entrepreneurship (eSpace), and the Silicon Flatirons Centre for Law, Technology and Entrepreneurship in the Law School (SFC). Here, the focus is placed on the *Silicon Flatirons Centre for Law, Technology and Entrepreneurship (SFC),* which is an interdisciplinary research centre for analyzing the changing dynamics in the telecommunications industry and regulatory environment, and preparing students for leadership and entrepreneurial careers. SFC has earned national prominence for its research, publications and leading conferences that debate legal and policy issues, foster practical solutions and innovative ideas, facilitate networking and produce scholarship. It serves as a source for new ideas, a forum for discussions and research, and a campus platform for the technology community.

- **Aalto University**

  The university was established in January 2010 by the merger of the Helsinki School of Economics, Helsinki University of Technology and the University of Art and Design Helsinki, with the aim to become to a more innovative and entrepreneurial university, with a multi-disciplinary education and research platform and the potential to become a globally recognized Finnish university brand. Building on the combined 300-year history of three prestigious universities, Aalto has become a trendsetter for academic entrepreneurship and innovation in Finland, and is also an inspiration for other universities internationally. Within Aalto University's entrepreneurial ecosystem, the research focus is placed on *Aalto Centre for Entrepreneurship (ACE),* which offers innovation, commercialization and start-up services for researchers, students and other stakeholders and develops research and education for innovation and growth entrepreneurship across all Aalto schools; and on the *Design Factory,* which is a symbiosis of conceptual thinking and cross-disciplinary hands-on doing, promoting a paradigm shift in education and business through collaboration between students, researchers and business practitioners. The Design Factory's focus is on creating a culture of action and hands-on learning, which does not necessarily hold entrepreneurship or setting up a business as the ultimate goal, but does facilitate the creation of many innovative start-ups due to a vibrant entrepreneurial environment. Therefore, the Design Factory functions also as a platform and launch pad for start-ups, which then may take advantage of ACE's services, avoiding the conventional type of classroom teaching and focusing instead on challenge-based learning, especially in product and service planning and design. These two units work closely with Aalto Entrepreneurship Society, Aalto Start-Up Centre and the Small Business Centre. Three specific factors distinguish Aalto, especially ACE, from other universities in Finland: (i) a much higher level of human resources and entrepreneurial and innovation activities than in other Finnish universities; (ii) a much bigger volume of financial resources, largely due to the location in the capital region and to the Aalto Fund, the capital that ensures the functioning of Aalto as a foundation-based university; and (iii) extremely strong support from the management, which considers entrepreneurship an important part of the institutional strategy. In addition, a key element for promoting the Aalto entrepreneurial culture is the students, which are seen as the driving force and best marketers to one another. Students taking the initiative appear to be an important facilitator of the entrepreneurial process, especially when they are part of teams where researchers and business angels come together via the matchmaking activities organized by ACE. Aalto's student-based entrepreneurship society AALTOES is the largest and most active in Europe.

- **University of Jyvaskyla**

  The university was founded in 1863 as the first Finnish-speaking teacher training college and was renamed in 1967 as Jyväskylä University. It is a very traditional, research-based university, with long traditions in providing education and skilled labour force for maintaining Finland's position as one of the best educational systems in the world. Here, the transition to an entrepreneurial university has been slower than at Aalto University, but academic entrepreneurship has been present since 2005 and gained ground ever since, with significant efforts currently being made for establishing a university-wide entrepreneurship strategy. The target points at this university are the *Jyväskylä University School of Business and Economics (JSBE),* where entrepreneurial education and research, especially family business, have a strong foothold; and the *Research and Innovation Office,* which focuses on entrepreneurship, business planning, start-up funding advice and ideas, business assessment by venture capitalists, help in refining a business idea and guidance for a business plan. In addition, the *Agora Centre*, which is a separate, interdisciplinary and networked institute of the University of Jyväskylä, was also included in the research, as it conducts, coordinates and administrates top-level research and development related to the knowledge society and human technology. Agora Centre's R&D is carried out in the form of fixed-term projects in co-operation with other university schools and institutes, as well as with business, the public sector and other relevant parties. The Agora Centre also promotes researcher training through various research projects.

- **University of Turku**

  The University of Turku was Finland's first Finnish university, established in 1920 with the help of a fund-raising campaign. Two key points of this university's entrepreneurial ecosystem were selected: (i) *Turku School of Economics (TSE),* which was founded in 1950 on an initiative of the local business community, and remained private until 1977, when it became public. TSE is nowadays a powerful part of the university and a highly respected business school, with a broad scope and intensity of networks and dialogue. R&D co-operation has been a cornerstone of its very existence since inception; and (ii) the *Centre for Collaborative Research,* which is much younger (founded in 2011) and ensures a strong link between TSE researchers, industry and society. The Centre's mission is to increase the number of TSE's externally funded research projects in key focus areas, such as business competence (corporate and organizational decision-making and enterprise resource planning), innovation research (new products, production methods, marketing and organizational innovation), entrepreneurship, management accounting and business networks.

- **Lappeenranta University of Technology (LUT)**

  Since its 1969 inception, LUT has the longest natural link between business and technology in Finland. It promotes business generated by scientific research and commercialized through research-based start-ups that are supported by the university's own investment company Lureco. LUT has been ranked as best in business technology cooperation by the Finnish business and economy publication *Talouselämä*. This small, yet dynamic university has a unique market position due to Lappeenranta's strategic location next to Russia and understanding of its markets. LUT is the most important university player in the energy sector, with 40% market share, and reflects its expertise in the Green Campus, a unique research and study environment. Recent developments triggered by the University Reform of 2009 in Finland have put entrepreneurial thinking and action at the foundation of LUT's strategy to compete with bigger universities. Our targets within the university include the *School of Business* and the *Centre for Training and Development*, which works with companies and organizations domestically.

3.2 Case study selection criteria

The selection of the seven case studies has been based on several criteria:

- **National and international reputation for overall academic performance and links with business and academic entrepreneurship** was the primary selection criterion. In terms of academic performance, it is noteworthy that in the 2011 Times Higher Education World University Ranking, MIT ranked 3rd, Colorado University at Boulder 32nd, and the University of Utah 82nd. Aalto University could be found in the 251−275 category, and the University of Jyväskylä in the 351−400 category[8]. University of Turku and the University of Jyväskylä were included in the 2012 Academic Ranking of World Universities (ARWU), also known as the Shanghai list, and Aalto University schools of engineering and economics ranked among the top 200[9]. In terms of links with business and entrepreneurial performance, some of the most important aspects have already been mentioned in the above introduction of the case studies, and further details are provided in section 3 of the paper.
- **The capacity to design and implement strategies for using alternative financing sources to government funding and become more entrepreneurially-oriented and competitive** was a criterion applied specifically for the selection of the four Finnish universities. This occurs in a context where all the 20 universities in Finland are state-owned and mostly financed by the state,

[8] https://www.jyu.fi/en/news/archive/2012/10/tiedote-2012-10-04-09-25-48-041611

[9] http://www.hs.fi/english/article/Five+Finnish+universities+make+it+onto+Shanghai+list/1329104632128

but several incentives and increased autonomy have been recently given to universities to meet the challenges of ever changing business environment and decline of public resources.

- **A balanced geographical coverage**: US cases were selected from the East Coast (MIT) and central US (Colorado University and University of Utah), while the Finnish cases come from the South (Aalto University), East (Lappeenranta University of Technology), West (Turku School of Economics) and Central part of Finland (University of Jyvaskyla).
- **University ownership***:* the three US universities are both public (Colorado University at Boulder, University of Utah) and private institutions (MIT), while the four Finnish universities are all public, according to the University Reform introduced in Finland in 2009.
- **Research intensity** - the US universities are all included in the category *Research Universities (very high research activity: RU/VH)* under the Carnegie Classification framework of institutional diversity in the US. The four Finnish universities are also *Research Universities* according to Finland's dual system of universities, which recognizes research universities (mainly focused on research, with similar funding criteria and usually longer history), and universities of applied sciences (mainly focused on teaching and applied research and development).

3.3 Research method and questions

The multiple case study approach of qualitative research was deemed as most appropriate for this investigation due to the variety of institutional, economic, social and cultural backgrounds of the seven universities, or as Flick puts it, a "pluralisation of life worlds and patterns of interpretation" (Flick 2006: 12) that is better addressed through locally, temporally and situationally limited narratives of the issues of concern.

The primary data collection was based on face-to-face and phone interviews structured according to a common interview guide, and was complemented by secondary data gathered through desk research of the respective centres' websites, annual reports and various other publications, press releases, etc.

The multi-dimensional analysis is structured along three main axes:

- *Institutional context*, comprising: UBC origins, stakeholders, financial resources;
- *Process*: drivers, barriers, motivations, objectives;
- *Results*: UBC benefits and impact for stakeholders.

The findings derived from this multi-dimensional analysis serve as basis for several recommendations for stimulating UBC in other universities in Finland and in other countries that seek best international practice to inspire their own efforts.

4 Analysis of case studies

4.1 Institutional context for UBC

4.1.1 Origin of UBC

A key feature of the US case studies is the long-standing nature of UBC links that have developed over the last five-six decades or so within complex innovative and entrepreneurial environments. The centres created more recently came to fill existing gaps in the functioning of the ecosystem and further improve its overall performance, illustrating a dynamic evolutionary process that reacts to market challenges, declining public budgets and education and research demands.

For example, **MIT** encouraged joint research among departments and with business and other leading research institutions since inception, and introduced entrepreneurship subjects as early as the 1960s. In 1990 a MIT-wide entrepreneurship program was proposed to educate and develop entrepreneurs for successful high tech ventures. This vision laid at the foundation of the *Martin Trust Centre for MIT Entrepreneurship*, which was created with co-sponsorship from MIT Sloan faculty across multiple disciplines to serve not just the Sloan School of Management, but all of MIT, in order to increase and provide central coordination for MIT's entrepreneurship classes and student activities. The Centre connects theoretical knowledge underlying entrepreneurial success with practice, by linking entrepreneurial researchers with successful entrepreneurs and venture capitalists. The *Technology Licensing Office* started in the 1960s and was reorganized in 1985, continuing a practice of patenting inventions and licensing agreements initiated in the 1930s. The *Deshpande Centre*, established in the School of Engineering in 2002, is a more recent initiative that came to fill the "innovation gap" in MIT's ecosystem between technological concepts and commercial reality caused by fear of risk, reduced government spending on basic and applied research, the limited financial ability of small businesses to identify and promote untested technology and the disconnect between academia and the marketplace.

The **University of Utah (the 'U')** has an entrepreneurial mission that can be traced back to the 1950s, when some UBC was carried out in the form of industry sponsorships for research. The U created its *Technology Commercialization Office* in 1967 to manage its technology transfer and intellectual property, and establish commercial partnerships to develop products based on technologies developed by university faculty, staff and students (Crispin, 2011). In 1968, the *Research Park* came to existence, and was one of the first 10 in the country (Charland, 1989). During the 1980s, then U's president Chase Peterson coined the term "academic capitalism" and rose to prominence as one of the nation's leading advocates of commercializing academic research and technology. A variety of institutional policies and practices were introduced in a more formal and programmatic way in order to realize this goal. For example, the *Utah Innovation Centre* supported by the National Science Foundation during the early 1980s was an early technology transfer experimental precursor to the technology business incubators that are now a common occurrence in many universities. The state-sponsored *Centres of Excellence Program (COEP),* established in 1986, while not focused exclusively on the U, has been a major programmatic asset for the creation of start-ups based on university-developed technologies. COEP funded later stage research in order to mature innovative technologies that might be commercialized via new products and new companies by university faculty, with substantive financial participation by business partners (Tornatzky et al. 2002). The U's strengths in establishing industry partnerships come from its strategy to build links with new or small local technology companies, many of which were the university's own spin-offs. In January 2005, the U reorganized the commercialization of its industry-sponsored research, aiming to perform this activity more systematically across the campus and meet the needs of the entrepreneurial faculty. The newly created *Technology Venture Development (Tech Ventures)* took responsibility for a number of existing and new centres and programs, such as the *Technology Commercialization Office, the Utah Entrepreneur Centre* (renamed in 2006 the *Pierre Lassonde Entrepreneur Centre*) and the *Bureau of Business and Economic Research.*

The Silicon Flatirons Centre (SFC) was founded in 2000 at Colorado University's Law School as a national centre of excellence in telecommunications and technology with an ambitious three-fold mission: (i) to debate key technology policy issues by providing a forum for entrepreneurs, lawyers, industry professionals and policy-makers to discuss changing technologies, new business models and relevant legal issues associated with them, and to examine legal and regulatory reforms for technological change; (ii) to support and enable entrepreneurship in the technology community of the region; and (iii) to inspire, prepare and place students in Technology and Entrepreneurial Law[10]. Even if this centre is more recent than the previous US cases, it is embedded in a wide cross-campus system of "confederated entrepreneurship centres" at Colorado University that have longer entrepreneurial experience and operates in synergy with them.

In the Finish universities examined, entrepreneurial activities are much more recent (6-8 years), but their roots go much further back in time, to the research and innovation support centres of the 1980s and 1990s. Their entrepreneurial ecosystems are still in formation, and much of the boost to their development is due to recent government intervention, in the form of specific policies and programs, as well as the 2009 University Reform that played a crucial role in changing the traditional working culture of universities and put higher pressure for intensifying UBC. The European Commission's new policies on UBC and entrepreneurship have also steered efforts in that direction, as well

[10] http://www.siliconflatirons.com/aboutUs.php and SFC 2011 Annual Report

as social and fiscal challenges in EU and Finland, where significant cuts in the R&D budgets have been made. All the Finnish case studies (with the exception of LUT) have found inspiration for their entrepreneurial strategies by benchmarking some US universities and some European ones, especially in the UK, France, Germany and Spain. Different approaches to entrepreneurial activities can also be distinguished among the Finnish universities examined, subject to their institutional culture, resources, attitude to risk-taking and background in collaborating with the local business sector. Risk-taking seems to be highest in Aalto and LUT. The state and local businesses have very high hopes with regard to Aalto and its capacity to build a strong and unique entrepreneurial environment around the capital region. They have also made high investments for realising the best European hub for start-ups and student entrepreneurs. For LUT risk-taking is a matter of necessity, as it is a smaller university trying to compete against bigger, more traditional ones. Turku and Jyvaskyla universities are more traditional and the transition to an all-pervasive entrepreneurial university takes more time.

Aalto Centre for Entrepreneurship (ACE) was established in 2010 with the mission to coordinate the university technology transfer and support student entrepreneurship. However, its expertise has a long background, as the former Otaniemi International Innovation Centre (OIIC) that was set up in 1998 as part of the Helsinki University of Technology to provide innovation and research support services, alumni and career services, and coordinate several research and innovation special programs. ACE's big challenge from the inception was to get the licenses and patents to commercial use, in a context where potential technologies were present, but technology transfer was weaker in size and scope not only in Finland, but overall in Europe compared to the US. Several US and European universities like MIT, Stanford and Imperial College London have been benchmarked before ACE launched its own entrepreneurial campus, in an effort to identify best practice and adapt it to the specific environment of Aalto, which differed from that of US and British universities in several respects. For example, Aalto had a much lower availability of funding and presence of venture capitalists and business angels in Helsinki. Also, the public nature of the university determined a more intense search for funding from the government than from the private sector. To that was added the (overly-) important role that public organizations play in Finland's start-up world, as well as the need to compensate for a less developed coaching and mentoring culture in Finland and the lack of other actors that would be present in more established entrepreneurial ecosystems to ensure specific services necessary for the growth of the ecosystem (e.g. Stanford and Silicon Valley). ACE became fully operational in 2011 and had an intense activity, handling 193 innovation proposals, transferring 36 innovations into 8 companies, filing 45 patents and supporting the formation of more than 20 new start-ups by Aalto researchers and students (Aalto University Foundation, 2011). All these were records for the Aalto University. ACE was also the central actor in building a partnership with Stanford University's Technology Ventures Program.

The Design Factory started in 2008 as one of the three spearhead projects of Aalto University – Media, Service and Design factories that serve as experimental platforms, showrooms and sources of inspiration for all the stakeholders. The roots of the Design Factory go back to the 1980's, when a more practically-oriented style of learning was introduced at Helsinki University of Technology. In the 1990's the cooperation with the University of Art and Design Helsinki was started. When Aalto University was launched in 2010, also the Helsinki School of Economics and its students finally had a chance to participate in the Design Factory's programs. Some courses reach out beyond Aalto University borders to the University of Helsinki and Hanken School of Economics, such as the "Usability School", which gives students expertise in user-centred design, usability and user interfaces[11]. The Design Factory is in essence a platform for interaction between Aalto students, faculty and staff, researchers and local and global SMEs and corporations, sharing not only a physical space and supporting technologies, but also common values, philosophy, attitudes and ways of working.

Jyväskylä University (JYU) has adopted academic entrepreneurship since 2005 and continued to develop it ever since, but different priorities set a slower pace of development than at Aalto University. For example, JYU's Human Resources department has reacted more slowly to change certain regulations, such as encouraging employees to set up own businesses, which is very much promoted at Aalto. JYU has all the ingredients for entrepreneurial success, but to build a truly entrepreneurial university, time and organisational changes are required. JYU aims to develop its entrepreneurial strengths on the basis of a university-wide entrepreneurial strategy that is currently in the making, with clear goals yet to be defined. To this end, benchmarking of Aalto and Oulu universities, as well as Stanford, was carried out, and the strategy is expected to be launched soon. The best ideas for academic entrepreneurship come from the IT and Sport and Health Research and Education. The **School of Business and Economics (JSBE),** known as the Department of Economics until 1997, contributes to academic entrepreneurship through degree programmes in the fields of economics and business that have been taught since 1967. **JYU's Research and Innovation Office** was established in 2003 with the mission to support technology transfer and faculty entrepreneurship, to promote innovation activities in general, to counsel on industrial property rights and invention, to find and evaluate projects supporting invention, and to promote good technical, productive, and commercial use of inventions. **The Agora Centre** was established in 2002 in the University of Jyväskylä as a separate institute functioning as a multi-disciplinary and an internationally networked research centre. It focuses on the knowledge society and human-centred ICT that combines social and technological innovations for society, businesses and private citizens. Since 2012 the Agora Centre manages the *Entrepreneur in University Program*, which has the purpose to commer-

[11] http://www.soberit.hut.fi/kaytettavyyskoulu/tietoa/usabilityschool.html

cialize human-centred and research-based solutions or services. The entrepreneurs participating in the program work collaboratively with an interdisciplinary research team to develop and validate a business model to commercialize the research results and gain a competitive advantage from their ideas and business opportunities.

At Turku University, Turku School of Economics (TSE) has worked in close cooperation with local businesses since its 1950 inception. The cooperation has been traditionally conducted via management, but recent pressure for additional funding and the need for research that is relevant to business and the economy overall contributed to the broader involvement of faculty in UBC. TSE offers higher education on Entrepreneurship, Management accounting and Business networks. Commercialization of innovations at TSE and University of Turku started in 2011, with funding from the Finnish Innovation Agency TEKES. However, although innovation awareness is present, actual commercialization activities are still scarce. While education relies on cutting-edge research, entrepreneurial thinking and acting are still less developed among faculty members, but is constantly improving under the influence of a growing convergence of research and businesses in the Turku area and the recent emergence of various tools that help local companies to further develop. Some of the most concrete and relevant topics for business include commercialization of innovations, businesses renewal and tapping on new markets. **The Centre for Collaborative Research (CCR)** was created in 2011 to channel the expertise of TSE towards companies, and manage projects, networks and financing issues related to TSE's externally funded research projects in its key focus areas, business competence and innovation research. CCR has been actively involved in start-up co-operation and building some of the TSE's financing instruments that compensate for the scarcity of start-up-sponsors and business angels in the Turku area, just like anywhere else in Finland outside of Helsinki. CCR's activity has contributed to an attitudinal change amongst researchers, who are now more open to UBC, although there are still more initiatives to look for project funding for the sake of financing itself, rather than look for ideas from businesses.

LUT has a strong background in UBC due to a strong business and technology background, and sees UBC as a legacy that has been around since inception. LUT's entrepreneurial strategy has been inspired by the experience of several universities, mainly from Europe: Manchester University in the UK and others in Germany, France, Ireland and Spain. Russia's practical drive for entrepreneurship was also found interesting, but still in a very early stage, with research activities that are still elementary. In LUT's vision, the University must be integrated in society beyond research, and entrepreneurial education needs a holistic approach from kindergarten to university, with emphasis on attitude and hands-on skills, not necessarily on business planning per se. LUT's strong business and technology background, more practical and more UBC-oriented, and holistic emphasis on entrepreneurship distinguishes it from Turku University, which is a more traditional University, with a strong Human Sciences area of expertise. In contrast with the other Finnish universities examined, LUT has not been involved in benchmarking (with the exception of alumni cooperation, which is one area in Finland that has been closely benchmarked abroad), as they believe that importing any models is challenging since they need to be adapted to the local context. **LUT's Centre for Training and Development** has been operating for 20 years and is specialized in educational services and research projects for companies. All schools and centres like the EBRC (Technology Business Research Centre) also reach out to companies and offer services, especially related to research. LUT values and strategy foster entrepreneurial thinking and action amongst students and faculty members.

4.1.2 Stakeholders of UBC

The main UBC stakeholders in the US and Finnish case studies are summarized in Table 1 below.

University	Stakeholders		
MIT	***Technology Licensing Office*** MIT, MIT faculty inventors, investors, companies	***Martin Trust Centre*** MIT, MIT students and faculty, entrepreneurs	***Deshpande Centre*** MIT, MIT faculty and students, venture capital companies, other companies, industry people
U	***Tech Ventures*** **Public:** Tech Ventures with its Entrepreneurial Faculty Scholars (EFS) and EFS Executive Committee, and its departments – the Technology Commercialisation Office and the Pierre Lassonde Entrepreneur Centre, David Eccles School of Business and its Bureau of Economic and Business Research (BEBR), Sorensen Centre for Discovery and Innovation, University Venture Fund (UVF), University Impact Fund (UIF), the Research Park, local development agencies **Private:** University of Utah start-ups, local business community (chambers of commerce, Utah Technology Council, Economic Development Corporation of Utah), business firms, banks, etc.		
CU	**Silicon Flatirons Centre for Law, Technology and Entrepreneurship** **Public:** "C*onfederated centres of entrepreneurship*": Leeds Business School with its Deming Centre for Entrepreneurship, the Management and Entrepreneurship Division and the Centre for Education on Social Responsibility (CESR), the Entrepreneurship Centre for Music, the Alliance for Technology, Learning and Society (ATLAS), the College of Engineering and Applied Science and its Engineering Entrepreneurship Program (E-ship), the Technology Transfer Office, Centre for Space Entrepreneurship (eSpace), the cross-campus club for entrepreneurship StartupCU, CU Law School, CU Interdisciplinary Telecom Program (ITP). Government agencies only episodically involved in collaboration with SFC. **Private**: SFC's supporters (Comcast Corporation, Google, T-Mobile USA, Walt Disney Company, Time Warner Cable, Cisco Systems, Verizon, Microsoft, Ericsson, National Cable and Telecommunications Association (NCTA), DISH Network, CableLabs etc.), law firms and individuals), SFC's partners (communications technology professionals, the Federal Communications Bar Association, etc.		
AU	***Aalto Centre for Entrepreneurship*** **Public:** TEKES, the state of Finland, all 6 schools of Aalto University. **Private**: Nokia, Microsoft, paper companies, venture capitalists and lawyers, Aalto-based start-ups, Helsinki business community, ACE spin-offs, Start-up Sauna and Aalto Venture garage, Aalto alumni acting as business angels.	***Design Factory:*** **Public**: TEKES, all schools of Aalto **Private**: Kone, other companies	
JYU	***Agora Centre:*** **Public:** JYU schools of IT, Psychology, Sports and Health Sciences, City of Jyväskylä, TEKES, SITRA, public hospitals **Private**: Metso, Ixonos, service and design companies	***School of Business and Economics:*** **Public:** TEKES **Private:** local companies	
TU	***Centre for Collaborative Research*** **Public:** TSE Schools, the City of Turku **Private**: maritime and seafaring industry, Boost Turku and other supporting organizations for start-ups, Finnish Business Angels	***Turku School of Economics*** **Public:** other schools of University of Turku, alumni	

LUT	***Centre for Training and Development*:** **Public:** LUT schools, Nordi, South Karelia University of Applied Sciences, City of Lappeenranta, VTT, TEKES **Private**: various firms from the forest industry (pulp and paper), metal Industry, energy Industry, IT, engineering Offices, financial sector, other industries	***School of Business*:** **Private:** SMEs **Public**: the State of Finland, local authorities, cities and municipalities around Lappeenranta region

Note:
MIT: Massachusetts Institute of Technology
U: University of Utah
CU: Colorado University
AU: Aalto University
JYU: Jyvaskyla University
TU: Turku University
LUT: Lappeenranta University of Technology

Table 1 – UBC stakeholders in the US and Finnish case studies

All the US case studies have a broad range of UBC stakeholders, with a variety of organizational designs and depth of connections between them. They are part of complex innovative ecosystems, comprising on the university side various academic departments and units, technology commercialization offices, academic administration units, faculty, students, student associations, etc. Business links were often initiated informally by faculty, university managers, alumni, etc. and later formalized and managed through specialized university structures. On the business side, partner companies range from large to medium- and small-sized ones, from established companies to start-ups, especially university start-ups, and from high-tech firms to legal firms, venture capital firms, etc. The relative proportion between public and private stakeholders varies from one case to another, but overall is higher for the private ones. University start-ups are an important stakeholder, especially at MIT and the University of Utah, and alumni play an important role in all cases.

For example, **MIT's** Technology Licensing Office employees work with inventors on patents and licensing agreements, and maintain relationships with a range of businesses and venture capital companies that can be matched with MIT inventors. The Martin Trust Centre coordinates a large number of different programs targeted to students and designates industry mentors ("entrepreneurs in residence") to work with students. The Deshpande Centre is organized around its grant requests for proposals from faculty-led research teams and the selection process. It also involves carefully chosen "catalysts" from industry to help guide grantees, and carries out networking activities with businesses to give MIT researchers access to venture capital companies. The collaborations run by these offices are beneficial to the entire MIT community, both in terms of the services offered and in the prestige that they have added to the institution.

Tech Ventures at the University of Utah, with its Entrepreneurial Faculty Scholars (EFS) and EFS Executive Committee, and its departments – the Technology Commercialization Office and the Pierre Lassonde Entrepreneur Centre, is at the centre of a complex institutional system of entrepreneurial organizations. Also, **Silicon Flatirons Centre at Colorado University Law School** is embedded in a model of "*confederated centres of entrepreneurship*" that comprises several institutions across campus that work in synergy to realize the university policy goal to become a leading entrepreneurial university in the world. A notable role in SFC's entrepreneurial ecosystem is played by its *supporters,* who are community members (business firms, law firms and individuals) interested in law, technology and entrepreneurship, and who participate in the debate around technology policy issues, facilitate networking and inspire student interest in technology law. Among the supporters, individuals account for a large share, which is explained by the nature of these individuals. They are alumni or successful entrepreneurs, venture capitalists, business angels, many relocated from elsewhere, being attracted by Boulder's small, but vibrant community with a flourishing entrepreneurial spirit, a world-class university and a supportive start-up scene. Law firms comprise the majority of the SFC's Energy Initiative sponsors. Supporters' involvement takes place primarily through sponsorships and participation in the SFC's Advisory Boards: (i) *Silicon Flatirons Board* (includes successful venture capitalists, top executives at publicly traded corporations, and partners at large law firms); (ii) *IT & IP Advisory Board* (includes leaders in the educational, entrepreneurial and legal communities); and (iii) *Entrepreneurship Advisory Board* (includes law and business schools students and professors, venture capitalists, successful entrepreneurs, top executives at established companies and attorneys). In addition, *SFC's partners* within the CU system, in the local community and nationally allow for greater cross-fertilization of ideas and facilitates networking across programmatic and geographical boundaries (see Table 1 for examples of partners).

In the Finnish case, UBC stakeholders are also part of complex ecosystems that include various university departments and units, large and smaller-sized companies, national, regional and local authorities, etc. These ecosystems appear to be relatively smaller in size than in the US cases, as they are also much younger. Another important distinction is also the higher proportion of public stakeholders relative to private ones, and the much smaller proportion of local entrepreneurs, venture capitalists and business angels. The involvement of alumni is also much more limited in the Finnish cases, although it has grown in recent years, especially at Aalto University and LUT.

At Aalto University, the Aalto Centre for Entrepreneurship works mainly with private partners from the Helsinki-based community: venture capitalists and business angels, lawyers, financing organizations (especially the Finnish Innovation Agency TEKES) and various companies, from Aalto-based start-ups to large companies like Nokia and Microsoft that are present with long-term R&D programs. Public partners are various players within Aalto University framework, such as all the six schools, the Executive Education program and the alumni. The Design Factory shares many of these same stakeholders, but most noteworthy is KONE among the private ones, and TEKES and all the schools of Aalto University among the public ones.

University of Jyvaskyla's entrepreneurial ecosystem is more locally-centred, with Jyvaskyla-based public stakeholders such as JAMK University of Applied Sciences, JYKES - the Regional Development Agency, the City of Jyvaskyla, and ELY-Centre for

Economic Development, Transport and the Environment (which operates also in other major cities). Another important public stakeholder is the Jyvaskyla Protomo Centre, which is a crucial tool for fostering commercialization and entrepreneurial culture amongst students and faculty, and operates closely with the eight other Protomo centres in Finland, with the Technical Research Centre of Finland (VTT), various start-ups and Nokia. The Agora Centre has a broad range of public stakeholders, such as the JYU schools of IT, Psychology, Sports and Health Sciences, the City of Jyväskylä, government agencies like TEKES and SITRA, public hospitals, etc. Private stakeholders include Metso and Ixonos corporations that operate locally and globally, and other service and design companies. The School of Business and Economics is mainly related to public partners like TEKES and private local companies.

At Turku School of Economics, the Centre for Collaborative Research, as well as the whole School, operate especially with other schools of the University of Turku. Among the private partners, maritime and seafaring industry holds a very special place, as Turku is an historical seafaring and ship-building city, which has been suffering dramatically lately from global competition. Supporting organizations for start-ups, such as Boost Turku and Finnish Business Angels, are growing in importance thanks to the growing emphasis on entrepreneurship. Overall, TSE is placing a lot of attention nowadays on its alumni - a resource that has been insufficiently tapped in Finland and is a lot less developed compared to the US.

At LUT, the main stakeholders of the School of Business are public organizations like the state of Finland, local authorities and cities and municipalities around the Lappeenranta region. The Centre for Training and Development, on the other hand, has a broad range of private stakeholders, especially from the forest, metal, energy, engineering and financing industries. Public organizations such as South Karelia University of Applied Sciences, City of Lappeenranta and Finpro are also present.

4.1.3 Financial resources

The financial resources for UBC in the US case studies come from a variety of sources, such as the university, business firms, foundations, alumni, entrepreneurs and government agencies. The weights of each source in the overall budget vary from one case to another. Government funding seems to be a key differentiating factor, as some cases rely more heavily on this source, while others to a much lesser extent, as briefly discussed below:

(1) Higher contribution of government funding, e.g. MIT:

MIT's research was funded in FY2013 by the federal government to about 70% (472.6 M) of its overall budget, while state, local and foreign governments contributed 6% ($38.3 M). Industry funding accounted for 16% ($109.7 M), foundations and other non-profits for 7% ($48.4) and MIT internal revenues for 2% (12.1M)[12]. The activities of the Martin Trust Centre and the Deshpande Centre, while quite different from one another in terms of objectives, responsibilities and roles and target groups, are similar in that neither directly involves the government. The Martin Trust Centre is funded mainly by MIT, but it also raises some money from corporate sponsors and alumni. The Deshpande Centre was founded with an initial donation of $20 M by Gururaj "Desh" Deshpande, the co-founder and chairman of Sycamore Networks Inc. and wife Jaishree. It depends on the financial and professional support of alumni, entrepreneurs, and investors to provide a sustainable source of funding for its operating costs. In addition, as all patents developed using MIT resources belong to MIT, after cost recovery, about one-sixth of the revenue is allocated to the Centre (about $40,000/year), most of which is used for maintenance fees on licenses. The Centre also requests that spin-outs donate some equity, but this is not mandatory. While these sources provide some funds, they are not sufficient to fund the entire Centre. The Technology Licensing Office is mainly funded by MIT, and also has ongoing contact with government agencies in its patenting activities and collects some royalties, patent reimbursement, and equity cash-ins.

(2) *Lower contribution of government funding,* e.g. Tech Ventures, Silicon Flatirons Centre:

For **Tech Ventures**, the most important funding source, far ahead of the others, is business, in the form of industry-sponsored research overheads and commercial sponsorships, royalties from licenses and patents, and endowment returns. Revenues from both commercial research and licensing have increased over the last years, with a more significant growth of the latter. In 2011, Tech Ventures raised seed funding of over $100 M for investments in the university start-ups. Venture funding over the last five years accounted for nearly $300 M, plus nearly $430 M in commercialization grants from the government. Most of this funding came from outside the state and was a direct investment in the state's future economic development (Tech Ventures, 2011). The main funding source estimated to grow in the future is equity in its own start-ups, which is now starting to accumulate. Also, revenues from current endowments are envisaged to be used for scholarships. Government funding is present at the University of Utah mainly in the form of the *Utah Science, Technology and Research Initiative (USTAR)*, a long-term investment in the state of Utah's economic future based on strengthening the university's research skills and the commercialization of its research-based technologies for job creation throughout the state. The USTAR Initiative is funded through SB (Senate Bill) 75, which was passed in 2006 with overwhelming support by the Utah Legislature, as a result of the lobby made by Utah's business community (chambers of commerce, the Utah Technology Council, the Economic Development Corporation of Utah,

[12] Federal funding came from the Department of Defense (17%, $117.5 M), 13% came from the Department of Energy ($90.9 M), 20% from the Department of Health and Human Services (133.7 M), 12% from the National Science Foundation ($81.5 M), 4% from NASA ($30.2 M) and 3% ($18.8 M) from all other federal sources. http://web.mit.edu/facts/research-expend.html

and many local economic development agencies). SB 75 allocated $179 M to the USTAR Initiative, as well as $15 M in ongoing annual funding to support research teams at the University of Utah and Utah State University, $4 M to support economic outreach programs around the State, and $160 M toward the construction of new research facilities at the University of Utah and Utah State University[13]. The funding channelled through USTAR for the University of Utah is used to recruit world-class researchers and support start-up packages for faculty with proven track records of research and commercialization in 12 key areas (research clusters)[14].

Silicon Flatirons Centre at Colorado University relies primarily on business funding, in the form of sponsorships from supporters, which account for over 90% of the budget. The sponsorships are granted in support to the overall mission of the Centre, rather than for specific projects. A secondary funding source is Colorado University, which only accounts for a very little share of the SFC budget (less than 3%)[15]. The main financial focus remains on the supporters' sponsorships, but grants from foundations, such as the Kauffman Foundation, are also envisaged as a possible new funding source to be better exploited in the future.

In the Finnish case studies, the government is the primary funding source, as the four universities are all state-owned and state-financed to about 70% of their current budgets. The centres examined within the four universities are funded directly from their respective universities' annual budgets in a "trickle-down" effect. The search for funding from private and other alternative sources has been stimulated by the University Reform of 2009, as mentioned earlier, but the change in the balance between government institutional (basic) and competitive funding, and funding from private sources has not changed significantly since 2009. Data shows that at Aalto University, during 2010-2012 government basic funding increased from 61% to 64%, while government competitive funding from the Finnish Innovation Agency TEKES decreased slightly from 11% to 10% and that from the Academy of Finland increased slightly from 7% to 8%[12]. During the same period, corporate funding has increased from 5% to 6%. At the University of Jyvaskyla, government basic funding decreased from 68% in 2009 to 67% in 2011[13] [14] [15], while government competitive funding from TEKES increased from 2% to 4% and that from the Academy of Finland increased from 8% to 11%. Private business funding dropped from 6% to 5%. Basically, the proportions between the funding sources of these two universities show no evidence that the 2009 University Reform has had any significant impact on the universities' overall budget composition. Rather, what

[13] http://www.ustar.utah.edu/about-ustar

[14] http://www.ustar.utah.edu/research-clusters

[15] Interview with Phil Weiser, the Center's Executive Director and Founder, 19 October 2012.

[11] http://www.aalto.fi/en/about/organization/

[12] http://www.aalto.fi/en/about/reports_and_statistics/aalto_university_annual_report_2012.pdf

[13] http://issuu.com/universityofjyvaskyla/docs/yo_2011_vuosikertomus_sivuttain?mode=window&pageNumber=16

[14] https://www.jyu.fi/vuosik/vuosikertomus2010

[15] https://www.jyu.fi/vuosik/vuosik_09/talous

seems to be a notable development is that there are more and more small units within the two universities that started commercializing university R&D activities and know-how. Building an entrepreneurial university is a long process and it takes time to see clear results.

Aalto University is a foundation-based university, whose capital is concentrated in the Aalto University Fund that amounts to EUR 700 M collected between 2008 and 2010 from donations (EUR 500 M from the government and EUR 200 M from Finnish industries and other financiers). The Fund aims to provide a competitive, entrepreneurial and high-growth ecosystem for the capital region and all of Finland. Aalto Centre for Entrepreneurship is primarily funded from the Aalto University's budget. It also receives government competitive funding from the Finnish Innovation Agency TEKES (about EUR 5 M per year for commercialization activities) and generates own resources to about 20% from EU projects, the city of Aalto and the state of Finland, the Ministry of Culture and Education, the Finnish Academy Fund, etc. The Design Factory's annual budget amounts to EUR 2 M, most of which coming from the Aalto University budget. Internal resources are generated from partnership agreements with local companies.

University of Jyvaskyla's total budget of approx. EUR 217 M is constituted primarily from government basic funding (67%), while the rest is government competitive funding from the Finnish Academy (11%), private funding from companies and other businesses (5%), and self-generated resources from various projects for the Finnish Innovation Agency TEKES (4%), Ministry of Education and Culture and the Finnish National Board of Education (3%) and foreign sources (6%)[16]. The Agora Centre' s annual budget amounts to EUR 4 M and comes in a large majority of over 80% from outside the University of Jyvaskyla, from the Finnish Innovation Agency TEKES (60%) and the Finnish Academy (20%). EU funds account for approx. 10% and the rest comes from the university funds to cover some of the Centre's employees' salaries and facilities. The Jyväskylä University School of Business and Economics' (JSBE) had a total budget of 9.5 M EUR in 2011, of which 63% came directly from the JYU budget. The rest of the budget was covered by complementary financing including the Avance MBA programme, which is one of the few educational degree programmes in Finland which have a price tag on it.

At the **University of Turku,** the Centre for Collaborative Research has a total budget of EUR 600,000, constituted in equal parts from University of Turku basic funding (EUR 200,000), fees from the private sector for various services (EUR 200,000) and competitive funding from the Finnish Innovation Agency TEKES (EUR 200,000). **Turku School of Economics'** annual budget is EUR 21.6 M, of which two thirds (EUR 14M) come directly from the Ministry of Education and Culture and one third (EUR 7.6 M) from research funding and fee-based services.

[16] http://issuu.com/universityofjyvaskyla/docs/yo_2011_vuosikertomus_sivuttain

4.2 UBC process

4.2.1 UBC drivers

Four drivers for UBC have emerged as most important from our case studies:

(1) Availability of excellent people (managers, faculty, students, mentors, alumni, local entrepreneurs)

This driver has been mentioned as crucial for all our US case studies. One aspect in particular has been shown to have a major influence on the initiation and subsequent development of UBC - *the presence of institutional champions,* an aspect that is often present in the more individualistic US culture. At MIT, people, like Deshpande Centre's Executive Director, Leon Sandler, TLO Director Lita Nelsen and Associate Director Jack Turner or Martin Trust Centre's Managing Director Bill Aulet, with their vast business experience, have been key assets for the development of the respective institutions. Tech Ventures' Vice-President Jack Brittain and Michael Young, University of Utah's President during 2004-2011 had a key role in setting the vision and the implementation agenda for comprehensive entrepreneurship education and research within the university and ensuring adequate funding and faculty support for reaching the set goals. At the Silicon Flatirons Centre, Dean Phil Weiser, the Centre's founder and Executive Director, has played a key role in the development of the Centre thanks to his combined academic, technology and policy-making experience. The Centre also involves several top business professionals and local entrepreneurs in its activities, especially in the Entrepreneurship Initiative, which is one of the key instruments to connect the CU Boulder campus to the Colorado area's technology and start-up community and students across the campus.

This driver has been acknowledged as one of, if not the most important driver in Finland as well. The importance of institutional champions is also high, but in contrast to the US, in Finland they are hardly ever mentioned by names, as in the Finnish culture it is not usual to over-emphasize the role of an individual in a workplace. Work is extremely collectively focused, even if Finland tends to become a more individualistic country. A strong emphasis is placed on the high performance of faculty and students, and is also extended to the high performance of Finnish universities in international rankings. The performance of Finnish higher education system is recognized in the world and Finnish students top multiple world rankings. Nevertheless, although many Finnish universities are in the Top 500, no single university is in the Top 50. Therefore international rankings are one area where significant efforts for improvement are being made. This is also one of the reasons why Aalto University was established - to have at least one university that would shine in world rankings. The search for excellence is a key driver for success in the global competition, in the context of a small country as Finland.

(2) Availability and stability of financial resources

This driver has been mentioned as important in all the US case studies, where funding comes from various sources, including state and federal government, the university, business companies, alumni, foundations, venture capitalists, local entrepreneurs, etc. as discussed earlier. This variety of funding sources also implies a continuous need for flexibility and adaptation of fundraising strategies to the specificities of each source, especially in the context of declining government budgets and tightened company budgets in the recent years, as a result of the financial crisis. AT MIT, the Deshpande Centre considered financial sustainability as its number one challenge, as the Centre, similarly to the Martin Trust Centre, face financial constraints as neither is willing to accept funds that have strings attached. For Tech Ventures, the main focus in fund raising is the private sector, as government money is considered “too costly” in terms of time spent for the management of government grants and “too restraining” in terms of possibilities of using the outcomes of the research funded this way. A similar emphasis on private funding sources is also placed at the Silicon Flatirons Centre, where government funding does not play a significant role.

This driver is also becoming a crucial one in the Finnish university system. The 2009 University Reform was seen by many as a strong boost to all the universities to start serious fundraising beyond the state funding, officially declaring the times of “easy money”[17] gone. Alternative funding sources include business companies, other public organizations such as the Finnish Innovation Agency TEKES, the Finnish Academy, etc. as well as the European Union. Nevertheless, universities’ search for funding from the private sector faces an important ideological challenge, as Finnish companies that have been working with universities so far are often reluctant to pay a market price for continuing this collaboration which they consider to be highly subsidised by the state. Overall, the budget cuts determined by the economic crisis have accelerated a broad process of rethinking the whole Finnish educational system, among other economic fields. While the decline of overall government funding for university research, caused by budget cuts and increasing search for competitive funding seemed to be of little relevance to Aalto University, LUT and also JYU found them remarkably more important, even of strategic importance for LUT. This driver seemed to be especially important for LUT, since it is a smaller university that is located in a market region, which is less developed than Helsinki, Turku or Jyvaskyla and seeks to maximize a specific local asset, the proximity to and understanding of Russia and its markets.

(3) Regional and national development needs

Regional and national development have been acknowledged as important UBC drivers at MIT, in light of its major research and entrepreneurial potential and economic impact, while SFC has focused especially on the regional dimension of their UBC, as the Centre

[17] Education in Finland offers a multitude of free benefits that come at a high cost for the state: no tuition fees for EU citizens, free housing and a monthly stipend for students to the tune of approx. EUR 500, a compensation of 50% of the cost of train and many events tickets, etc.

has a strategic institutional policy to turn the university into a local convening platform for local and regional innovators. At Tech Ventures, regional development was seen rather as a benefit to the local economy than a driver of UBC, taking into account the significant impact of UBC on the local economy.

Among the Finnish universities, both national and regional development have been mentioned as important drivers of UBC, as the vision for UBC in Finland places universities at engines for regional and national economic development through innovation and entrepreneurship. Aalto University has a clear mission to contribute to the national economy, as well as a huge social demand for the services it that the university provides in innovation and in the start-up world. In particular, the Design Factory functions as a display window for Aalto, receiving over 10,000 visitors annually. The University of Jyvaskyla places a higher emphasis on the regional development.

(4) Institutional culture of collaboration, research, entrepreneurial education and technology commercialization

This driver has been highlighted especially in the US case studies. At MIT, it played an important role in the context of MIT's unique history and institutional goals to bring science to industry and agriculture and to learn by doing. These goals contributed to the institution's fascination with using technology to solve real world problems. Faculty have been consulting and working on industrial problems since 1865 and have been spinning off companies since the 1950s. Faculty, staff and students all echo the conviction that innovation and entrepreneurship are in MIT's institutional DNA and they share none of the ambivalence about business that typify many institutions whose original mission was to educate affluent young men. This driver appeared as an important one also at Tech Ventures and SFC, which are both part of established innovative and entrepreneurial ecosystems, strongly connected to the local and regional economies.

4.2.2 Barriers to UBC

Faculty attitude towards academic entrepreneurship was the main barrier identified in both the US and Finnish cases. In the US, it was mentioned both by Tech Ventures and SFC. At Tech Ventures, faculty opposition to academic entrepreneurship embraced many forms in the early days of the UBC, all being rooted in various fears of losing control over their research and hinder or prevent publication of the joint research results. Eventually, none of these potential threats turned out to be true in practice, which showed that faculty only feared what they did not know. Once they started to gain experience in collaborating with business partners, the university was able to use faculty peer-to-peer advising and training to address questions and keep fears in check. At SFC the inertia of the academics' status was also combined with a certain scepticism accumulated in the local business community vis-à-vis the university engagement with companies. Prior engagement efforts of the university didn't come to fruition and the university's entrepreneurial efforts were seen as a fundraising vehicle, without offering much in exchange. Another barrier was the lack of university incentives for rewarding spin-off creation by academics in the process of getting tenure. Therefore, the university entrepreneurship efforts didn't target the pre-tenured professors as much as they did students and the involvement of local entrepreneurs in various university events and teaching of entrepreneurship classes.

In the Finnish universities, many of the older generation faculty members believe that students should not be encouraged to become entrepreneurs until maybe 10 years into their careers. One reason for this may stem from decades ago, when setting up a company and initial investments were radically different from what they are today. Also the idea that universities exist for corporations to be able to hire new employees lingers on. There has been a strong change of heart and attitude lately and views are very different among the youth. In addition, there is also a fear shared by a great a number of researchers and other faculty members of business dictating the research needs more heavily in the future. In Finland, professors have great power and freedom over their work, and if a part of the academic freedom, which is one of the greatest reasons for choosing an academic career path in Finland, is considered by some to be threatened, many faculty members oppose the UBC process, although others see this as an opportunity to make greater impact.

Also contributing to the faculty attitude towards UBC is the insufficient recognition of UBC as academic activities and the lack of adequate incentives. Due to the fact, that the majority of the funding and academic promotion depend on research and teaching activities, innovation, entrepreneurship and other UBC can seen as tertiary and not that important. This topic was brought up especially in JYU, but the majority of Finnish universities do not reward faculty members for efforts in the area of UBC. Currently, management sees that UBC is part of the workload, while many faculty members no not necessarily feel this way, as mentioned by TSE. In LUT's Centre for Training and Development, they are able to encourage faculty members to cooperate with businesses, as this part is considered crucial for further development of UBC.

Another barrier is the **very early development stage of inventions** that requires additional funding by venture capital investors for further development of technologies before licensing. This has been mentioned by MIT's Technology Licensing Office as an obstacle that prevents the TLO from licensing faculty/student discoveries immediately. In response, the TLO helps inventors identify venture capital companies to finance start-ups where the additional development can be done.

4.2.3 UBC objectives

On an overall assessment, UBC objectives in the US and Finnish case studies can be divided into two broad categories:

(1) **"Internal" objectives focused on strengthening the research and education capacity of the university, while benefitting both students and faculty:** In regard to students, a very important objective is the introduction of new

experiential learning programs that can provide new business management and entrepreneurial skills, leadership and creative thinking capabilities. Student learning is also enhanced by their inclusion in joint research projects next to business partners, increased exposure to and connections with prospective employers through mobility placements and internships. A general belief was that broader skill sets and independent and creative mindsets give students better opportunities for employment. Also, the support for start-up formation by students and student employment in university start-ups was an important objective for UBC. For faculty, one of the most objectives for UBC was the exposure to real-world business problems and collaboration with business partners which has a positive impact on several fronts: advancing the academic research agenda, promoting interdisciplinary research, raising research funds for the academic labs, recruitment of new professors from the business and/or entrepreneurial community. In addition, UBC was also seen as a practical way to provide business management and entrepreneurship skills to faculty and support for start-up formation by faculty.

(2) **"External" objectives focused on strengthening the links with the local and regional community**, including business firms, government agencies, professional associations, entrepreneurs, venture capitalists, etc. These local actors are seen not only as potential employers for students and collaborators for the academic staff, but they are also considered as an important source of knowledge and expertise to tap for bringing real-world expertise to the classroom, for solving specific problems of the community and for connecting the university to broad networks of partners.

Overall, the internal and external objectives in Finland are very experimental and student-oriented and reflect the current change and building processes of entrepreneurial universities. In the US, the objectives also have a stronger financial orientation and UBC is expected to accumulate fair amounts of revenues to universities on an annual basis.

A summary of UBC objectives in the US and Finnish case studies is provided in Table 2 below:

MIT	**Technology Licensing Office** • Foster commercial investment in the development of inventions and discoveries flowing from the research at the MIT research, through licensing of the intellectual property **Martin Trust Centre for Entrepreneurship** Foster and develop MIT's entrepreneurial activities and interests in three primary areas: Education and Research (educational courses and executive programs powered by MIT's technology and business research), Alliances (business and technology partnerships for commercializing breakthrough academic research) and Community (a network of academic, government and industry leaders around the vision of entrepreneurial success) **Deshpande Centre** • Increase the impact of MIT technologies in the marketplace by providing a sustainable source of funding for innovative research and guidance to help it reach the marketplace

U	**Tech Ventures** • Provide funding for faculty's productive research without compromising the academic freedom to choose own research themes • Expose academic researchers to real-life problems of industry and business firms that they wouldn't encounter in the absence of industry-sponsored research • Provide business management and entrepreneurship skills to faculty and students • Match the industrial relations of the faculty with the support from the university which manages the research contracting services
CU	**Silicon Flatirons Centre** • Realize the university objective to become a convening platform for congregations of innovation actors at local, national and international level • Aggregate local community support for university start-ups and reinforce SFC's role as a catalyst of collective entrepreneurship and contributor to local socio-economic development • Help students become more attractive for employers and more prepared for building their own careers as entrepreneurs, by developing their entrepreneurial skills and mindset
AU	**Design Factory**: • Global networks and projects. Currently customers and projects on five different continents. • Real-life cases and collaboration. • To develop and cultivate passion-based, student centric learning culture, as well as the quality of research and education. **Aalto Centre for Entrepreneurship (ACE)**: • To drive innovation and business opportunities • To commercialize Aalto's R&D activities and know-how
JYU	**Agora Centre**: • Commercializing potential business cases • Developing the university innovation ecosystem • Real-life cases for students **Jyvaskyla School of Business and Economics** • Fostering and educating about entrepreneurship • World-class research to serve the university and local business environment
TU	**Centre for Collaborative Research:** • Translate scientific results into a language that makes sense for the public and companies • Channel the expertise of TSE towards companies and business environment • Gain information about project ideas from companies **Turku School of Economics:** • Gain internships and graduate thesis placements for students • Get extra funding
LUT	**Centre for Training and Development:** • Promote business generated by scientific research • Integration of cross-disciplinary competencies that can be applied to business problems. **School of Business** • Contribute to top-level academic research and discussion on technology-related business at the national and international levels

Note:
MIT: Massachusetts Institute of Technology
U: University of Utah
CU: Colorado University
AU: Aalto University
JYU: Jyvaskyla University
TU: Turku University
LUT: Lappeenranta University of Technology

Table 2 – UBC objectives for in the US and Finnish case studies

4.2.4 UBC motivations

On an overall assessment, the top 5 most important motivations for US universities appear to be: diffusion of innovation, collaboration as a strategic institutional policy, training students for the professional environment, accessing complementary expertise and providing an outlet for university research results. These motivations reflect a combined approach of the US universities that see UBC both as a tool for generating and diffusing innovation, and for improving students' education and the research capabilities of the university, rather than a reaction to the decline of government or institutional funding, or a response to top-down government policies and pressures. The importance given to the contribution to the national and regional economy differs markedly from one university to another, from maximum scores given to both at MIT, to moderate to low scores given at the other two universities that have a different structure of their funding sources and impact on the regional and national economies. At the opposite end, the 5 least important motivations are: government policy and/or political pressure, accessing industrial funding, declining institutional university funding and increase of competitive funding, as well as declining institutional university funding for university research caused by budget cuts, and accessing state-of-the-art equipment.

For the Finnish universities, the top 5 most important motivations are: contribution to the regional economy, collaboration as a strategic institutional policy, diffusion of innovation, contribution to the national economy and training of students for the professional environment. The top importance given to the contribution to the regional economy by the Finnish universities, followed at short distance behind by the contribution to the national economy (particularly at Aalto University), are noteworthy. This is closely connected with the Finnish vision of universities as engines for regional and national economic development through innovation and entrepreneurship. This mission to contribute to the national economy is explicit at Aalto University, while the University of Jyvaskyla places a higher emphasis on the regional development. Moreover, both types of motivations are likely to become more and more important in the future, as discussion and hands-on cooperation with local business operators continue to grow. The 5 least important motivations for UBC are: declining institutional university funding and increasing competitive funding, government policy and/or political pressure, declining overall government funding for university research, caused by budget cuts, to increase patenting & equity arrangements and access to state-of-the-art equipment & facilities. On the on hand, this suggests that UBC has not been adopted as a result of financial pressure caused by Finnish government budget cuts and increasing competitive funding, as universities still have significant resources, but rather as a form of preparation in front of changing times. The financial reasons have very little relevance to Aalto University, whereas especially LUT and also JYU find them remarkably more important, even strategic for LUT.

Table 3 summarizes the motivations for UBC and the relative importance attached to them (1: least important; 5: most important)

Motivations	MIT	U	CU	Average score US	Aalto	JYU	LUT	TU	Average score Fin-land
Collaboration is a strategic institutional policy	5	5	4	**4.66**	3.66	3.75	4.50	4	**3.98**
Diffusion of innovation	5	5	5	**5**	4	3.75	4	4	**3.94**
Training of students to the professional environment	5	3	5	**4.33**	3.30	2.75	4.50	4	**3.64**
To contribute to regional economy	5	2	4	**3.66**	5	3.75	3.50	4	**4.06**
To access complementary expertise	5	4	4	**4.33**	3.67	3.50	4	3	**3.54**
To provide an outlet for university research results:	5	5	3	**4.33**	3.67	2	4	3	**2.67**
To contribute to national economy	5	2	3	**3.33**	5	2.75	3	4	**3.69**
To find an exploitation outlet for research capabili-ties	5	3	3	**3.66**	3.30	2.50	4	3.50	**3.32**
Providing employment	4	2	5	**3.66**	3.30	3.25	3	3	**3.14**
To increase patenting & equity arrangements	5	5	1	**3.66**	3,67	2,75	1	3.50	**2.73**
Government policy and/or political pressure	3	4	1	**2.66**	3.30	3.25	3	3.50	**3.26**
To access industrial fun-ding	-	4	1	**2.50**	3.30	4	4	4.50	**3.95**

Decline of institutional university funding and increase of competitive funding	-	3	2	**2.50**	1.67	4.50	3.50	3.50	**3.30**
Decline of overall government funding for university research, caused by budget cuts	-	3	2	**2.50**	1.67	2.5	2.5	4.5	**2.80**
To access state-of-the-art equipment & facilities	-	4	1	**2.50**	1.67	2	1.5	3	**2.04**
Other		3*							

*Special state funding (U-STAR Initiative)
Note:
MIT: Massachusetts Institute of Technology
U: University of Utah
CU: Colorado University
AU: Aalto University
JYU: Jyvaskyla University
TU: Turku University
LUT: Lappeenranta University of Technology
Scores are averaged for the number of respondents from each university

Table 3 - Motivations for UBC in the US and Finnish case studies

4.3 UBC results

4.3.1 UBC benefits

The benefits derived from UBC in the US and Finnish case studies are manifold, and have been reported for all the stakeholders involved, from students and faculty to business partners and the local community. An important observation is that benefits do not remain confined to one category of stakeholders, but diffuse broadly among all of them and into the local and regional economy. Table 4 below summarizes the benefits identified for each case study.

	Students	**Faculty**	**Business**	**Community**
U	• Entrepreneurial skills, theoretical and practical experience in developing a business • Possibility to find a job and to work with companies through various internships	• Research funding for academic projects • Stability of the research labs and continuous engagement of students employed by the lab • Easier management of industry funding compared to funding from national or regional government programs	• Strong focus on and support to university spin-offs • Access to university graduates and student interns	• Economic benefits: job creation, tax revenues from university start-ups • Social and cultural benefits: positive social perception of entrepreneurs, stronger bonds between the university and the community, increased attractiveness of the university and the region to national and international talent and investors
CU	• New ways of learning • Achieving an entrepreneurial mindset as an additional asset in approaching careers • Contact with real world challenges	• Greater responsiveness to the needs of local business and entrepreneurs • Research funding from companies and alumni giving greater economic viability of academic projects	• Access to academic expertise, graduates as interns and future employees, to latest ideas and trends, ability to intervene in policy-making debates	• Access to university knowledge and expertise

AU	• Possibility to earn credit hours by planning or starting own company • Global perspective in everything • Positive and teamwork oriented learning environment	• Research funding • Possibility to test one's expertise outside the university boundaries • Possibility to make an impact in the national economy	• Leverage of TEKES and other forms of funding • Contact networks in Silicon Valley	• World-class entrepreneurial ecosystem • High-growth entrepreneurs • VC money from abroad
JYU	• Contact networks especially with local companies • Collaboration with SMEs • Recruitment channel	• A demand and possibility for multi-disciplinary research • Research funds	• Access to the latest research • Meeting point • Seminars and educational events	• Highly-skilled employees • A university city status, which is very important in Finland
LUT	• Expertise in doing business in Russia • Access to latest technology	• Financial incetives • Enhanced intrapreneurial and entrepreneurial skills	• Source of training and development • Leverage of EU funding	• Tax money via high earning employees • New innovation and services
TU	• Alumni cooperation • Enhanced recruitment possibilities	• Research funding • Possibility to make an impact in the regional economy	• Access to university graduates, and student interns • Source of contracted research, training and development	• Support for the maritime and seafaring industry • Global contact networks and perspective

Note:
U: University of Utah
CU: Colorado University
AU: Aalto University
JYU: Jyvaskyla University
TU: Turku University
LUT: Lappeenranta University of Technology

Table 4 – Benefits of UBC in the US and Finnish case studies

4.3.2 UBC Impact

On an overall analysis of the impact of UBC reported in our US and Finnish case studies, two broad types of impact can be identified:

(1) An 'internal' impact on the university, faculty and students. Here, one can further distinguish between:

- ***An impact on the university,*** arising from commercialization of university research and technologies and the revenues it generates to the university. This impact is particularly relevant in the case of MIT, where it is quantified by specific indicators (e.g. number of invention disclosures, number of patents filed and issued, number of licenses granted, number of companies started, etc). MIT's patenting/licensing portfolio included 706 new invention disclosures and \$147.5 M in total licensing revenue in FY12: \$54.09 M from royalties, \$10.43 M from patent reimbursements and \$2.75 M from equity cash-ins[18]. The Martin Trust Center monitors the number of graduates who start companies, thanks to the Shingle Project that collects information on companies started by MIT graduates.[19] Since 2002, the Deshpande Center has funded more than 90 projects involving more than 300 faculty members and their students with over $11 M in grants. About a quarter of the projects (26) have moved their technology to an outside venture, in most cases in the form of a start-up company (18 commercial ventures spun out) in which the innovators are engaged, having collectively raised over $350 M in outside financing. Together the companies have more than 400 employees.

At Tech Ventures, the commercialization of university research and technologies is also very important and turned the university into a research funding generator: as the University is the sole owner of the patents generated by its research, it receives royalty income (about 3-4%) from the product sales of its start-ups. The university also owns a small percentage of equity in these companies. Impact is quantified by a variety of indicators[20] that are made available in publications like the annual surveys of the Association of University Technology Managers (AUTM), reports of the Eccles School of Business or the Tech Ventures Annual reports (see the 2011 Annual report[21] for an overview of recent performance indicators).

The Silicon Flatirons Center of Law, Technology and Entrepreneurship (SFC) at Colorado University's Law School promoted a different vision on the role of the university in the local community: that of a local convener, inviting the local community in and looking inside the local business and entrepreneurs for knowledge and expertise.

In Finland, the UBC impact on universities is also very important and is likely to continue increasing in the future due to the 2009 University Reform. Finland's UBC impact figures are much lower than those in the US ones due to the size of the country, sizes of the universities and much sorter and less intense history of UBC. However, the biggest UBC impact on the university is expected to be seen in the increase of private funding share in the overall university budget (e.g. a slight increase in corporate funding from 5% to 6% at Aalto University during 2010-2012, as shown in section 3.1.3 'Financial re-

[18] "TLO Statistics for Fiscal Year 2012" http://web.mit.edu/tlo/www/about/office_statistics.html. Last accessed 13/02/2013

[19] People sign on to this voluntarily, so there are certainly companies missing.

[20] E. g. total research funds, number of university inventors, number of intellectual property disclosures, number of students involved in commercialization and innovation, number of technology licenses executed, total revenues from commercialization, number of start-ups, jobs created at state level, amount of tax revenues for the local economy, etc.

[21] Tech Ventures 2011 Annual Report, p. 5. http://content.yudu.com/Library/A1tbz4/2011AnnualReportTech/resources/index.htm?referrerUrl=http%3A%2F%2Fwww.techventures.utah.edu%2Fnews%2F2011%2F08%2F2011-annual-report-released%2F. Last accessed 13/02/2013

sources'). The change may take some time to become significant, taking into account that until recently any services provided by universities were considered "free" in the public eye, since universities have been owned and are still highly financed by public money.

- ***An impact on faculty and students***

  MIT faculty and students currently work with over 700 companies, including global space, automotive, pharmaceuticals, oil and IT industry leaders[22]. MIT Martin Trust Center monitors how the Center is being received by students by keeping track of the number of students in its classes and the number of wealthy alumni who make donations. The impact for students is measured by tracking the post-graduation activities of those who graduate with the entrepreneurship minor and the number of start-ups created by Business Plan Competition winners, who have started 27 businesses over the last 10 years throughout the state. At Tech Ventures, the impact on faculty and students is measured in terms of students' involvement in research projects (about 3,790 students) and in university start-ups, which is a distinctive feature of the University of Utah and sometimes compensates for limited personnel resources. University start-ups also provide jobs for students and other employees, being the largest local employer. The impact on students is also important for the Silicon Flatirons Center, where it is monitored in terms of student participation in the events hosted by the Center, students' satisfaction and feedback, opportunities for student employment, etc.

  In Finland, students are the biggest gainers, as they are able to tap on practical experience and direct contact with companies early into their studies. Working on projects with companies is a common occurrence for a student during the second or third year of their university studies, although projects may be publicly financed. Among faculty, there seems to be a clear distinction among those who are very keen on UBC, and others who want to stay as far as possible from it for various reasons discussed earlier (see section 'Barriers to UBC'). Obviously, the biggest impact on faculty is visible in the former category, among those who take the chance to test their expertise in the real world, gaining research ideas and being able to get real-life cases for teaching purposes.

(2) An 'external' impact on the local and state economy

According to a 2009 Kauffman Foundation Entrepreneurship Study, MIT alumni founded over 25,000 companies that created over 3.3M jobs and $2 trillion in annual world sales, many of them contributing to the birth of new industries, including biotechnology, streamlined digital technologies, local

[22] http://web.mit.edu/facts/industry.html

computer networks, defence, semi-conductors, minicomputers, advanced computers, and venture capital. Also, the activities of Tech Ventures Development at the University of Utah have a very important local and state economic impact. University start-ups provide jobs for students and other employees, being the largest local employer. The cooperation with business has strengthened the links with the local community and generated important revenues for the economy. In the 2011 FY university start-ups generated 16,617 jobs state-wide, \$779.9 M in personal income and \$95.3 M in state tax revenue[23].

In Finland, university start-ups are also one of the most important forms of 'external' impact. Aalto's ACE has developed a unified measuring system which can be applied at least nationally and which includes: a) the total number of start-ups; b) the total number of license agreements; c) average funds raised per start-up; d) licensing revenues. The number of Aalto University start-ups is currently about 10 per year, while the total number of license agreements is 2-3. Average funds raised per start-up were less than EUR 15,000 in 2011, but the estimation for 2012 is over EUR 200,000. Licensing revenues seem to be growing gradually. In 2011 they amounted to EUR 83,000 and are estimated to rise to EUR 100,000 in 2012. Another form of impact on the economy is the societal impact universities have regionally and nationally. Universities are extremely important for their local communities by providing jobs, tax money, and a certain image for the area. Universities provide private businesses, corporations and organizations with various services, free of charge. One main reason for this is that the priority has been placed on research and education, but as the times are changing, a rethinking of the relationship with companies is underway, from which students and faculty may also benefit.

5 Conclusions

The detailed exploration of the seven US and Finnish case studies shows some important similarities, but also differences in the UBC area. The Finnish examples are illustrative of the "European paradox" (i.e. strong research capacity and results, but lower capacity to translate them into innovative products), which, although much reduced in recent years, could be further reduced by removing several gaps and obstacles at the university-business interface and beyond. Our analysis highlighted several key issues that emerged from the experiences of the seven case studies, which are discussed below along the three axes on which the analysis has been structured, and are followed by a number of recommendations for further strengthening the UBC process:

(1) Institutional context for UBC

The institutional context for UBC has been analysed in terms of UBC *origins*, *stakeholders* and *financial resources*. The analysis has revealed that the *origins* of commercialisation of university research and entrepreneurship in the US case studies go back to the 1950-1960's and the process evolved within a university-wide system with a long tradition of combining the education and research potential of university schools and departments with the operational power of specialised units like technology transfer and licensing offices, and other forms of business and innovation support services. MIT has a loosely connected entrepreneurial ecosystem aimed to maintain a "free-flowing physical and emotional structure of the institution", while being able to bring MIT research to market and develop the next generation of entrepreneurs. Tech Ventures at the University of Utah and its departments are also part of a complex system for entrepreneurship and business education that works for the implementation of the goal of "total mission integration" of university education, research and entrepreneurial activities, with large involvement of the students in all these activities. Silicon Flatirons Centre at Colorado University is part of a "confederated centres of entrepreneurship" that work in synergy to teach and promote entrepreneurship and business education.

In the Finnish universities examined, the origins of UBC are much younger and the university innovation and entrepreneurship ecosystem is still in formation. A similar synergy between education, research, commercialisation and entrepreneurship is observed, but at a much smaller scale and intensity, considering the size of the country and of the respective universities, and the earlier stage of development of UBC activities. Government intervention gave an important boost to the development of UBC, especially in the form of the 2009 University Reform that initiated a change in the traditional working culture of universities and encouraged them to become more entrepreneurial. In addition, European Commission policies on UBC and entrepreneurship and social and fiscal challenges in EU and Finland that brought about cuts in the R&D budgets had a role in enhancing UBC activities, but the pace of change is still slow. Most of the Finnish case studies have found inspiration for their entrepreneurial strategies in the experience of some major US universities and some European ones, especially in the UK, France, Germany and Spain, adapting it to the realities of each context, especially in terms of institutional culture, resources, attitude to risk-taking and background in collaborating with the local business sector. Thus, different approaches to entrepreneurial activities can also be distinguished among the Finnish universities, with Aalto, on one hand, as an example of high public and private investments for realising the best European hub for start-ups and student entrepreneurs, and on the other, Turku, Jyvaskyla and LUT universities embarking on the entrepreneurial journey as a strategy for increasing competitiveness and raising funds from alternative sources to government.

Both the US and the Finnish case studies are similar in that they have a broad range of public and private UBC *stakeholders*, with a variety of organizational designs and depth of connections between them. The relative proportion of the public partners is, however, much higher in the Finnish cases, while the proportion of private partners such as local entrepreneurs, venture capitalists and business angels is much lower, as this funding source is much less developed in Finland, as in the rest of Europe. The involvement of alumni is also much more limited in the Finnish cases, although it has grown in recent years, especially at Aalto University and LUT. This structure of the stakeholders is reflected into the structure of the university *funding sources*, which is more government-dominated in the Finnish case studies. Even if the search for funding from private and other alternative sources has been stimulated by the University Reform of 2009, the change in the balance between government funding (institutional and competitive) and private funding has not changed significantly since 2009. Furthermore, the involvement of business professionals and entrepreneurs in university governance, entrepreneurship education and program development is much less significant than in the US cases.

(2) Process of UBC

The process of UBC has been examined in terms of *drivers, barriers, objectives and motivations*.

Four key *drivers* have been identified, such as the availability of excellent people (managers, faculty, students, mentors, alumni, local entrepreneurs, etc.), availability and stability of financial resources, regional and national development needs, and the institutional culture of collaboration, research, entrepreneurial education and technology commercialization. An important cultural difference appeared in the attitude towards the recognition of institutional champions - an aspect that is often present in the more individualistic US culture, but much less so in Finland, where it is not usual to over-emphasize the role of an individual in a workplace. Work is extremely collectively focused compared to the US, even if Finland tends to be more of an individualistic country. The availability and stability of financial resources has been recognised as a key driver in both groups of universities, but their approach to different funding sources differs, with much higher reliance on government money in the Finish cases, and also an important ideological challenge from the private sector, as Finnish companies are often reluctant to pay for services provided by universities, which they consider to be highly subsidised by the state. The two groups of universities also differed in their approach to regional and national development needs. At MIT, both regional and national development have been acknowledged as important drivers, in light of MIT's major research and entrepreneurial potential and economic impact both nationally and regionally, while SFC has focused especially on the regional dimension and Tech Ventures sees regional development rather as a benefit to the local economy than a driver of UBC. The Finnish universities see both national and regional development as important drivers of UBC, as the vision for UBC in Finland sees universities as engines for regional and national economic development through innovation and entrepreneurship. The national emphasis is much stronger at Aalto University, while the University of Jyvaskyla places a higher emphasis on the regional development. The institutional culture of collaboration, research, entrepreneurial education and technology commercialization appeared to be much stronger and established in the US cases than in the Finish ones.

Barriers to UBC came mostly from faculty attitude towards academic entrepreneurship, as reported in both the US and Finnish cases. However, as two US cases have shown (Tech Ventures and SFC), none of these potential threats turned out to be true in practice, which showed that faculty only feared what they did not know. In addition, another important barrier, highlighted mainly in the Finnish cases, is the traditional mentality of academics, the insufficient recognition of UBC as academic activities and lack of university incentives for turning this mentality into one more open and receptive to research commercialisation and academic entrepreneurship. Another barrier was also the very early development stage of inventions that requires additional funding by venture capital investors for further development of technologies before licensing, and extends the time to market.

UBC *objectives* appeared to be grouped into two broad categories: “internal” objectives focused on strengthening the research and education capacity of the university, while benefitting both students and faculty, and “external” objectives focused on strengthening the links with the local and regional community, including business firms, government agencies, professional associations, entrepreneurs, venture capitalists, etc. These actors are seen not only as potential employers for students and collaborators for the academic staff, but they are also considered as an important source of knowledge and expertise to tap for bringing real-world expertise to the classroom, for solving specific problems of the community and for connecting the university to broad networks of partners. The top UBC *motivations* appeared to be quite similar for the US and Finnish universities, with some small differences in regard to specific motivations, such as collaboration as a strategic institutional policy which topped the list in the US cases, and the contribution to the national and regional economy which topped the list in the Finnish cases.

(3) UBC results

UBC results have been examined in terms of benefits and impact. Both the US and the Finnish case studies reflect a multitude of UBC *benefits* that diffuse broadly span across all the stakeholders involved, from students and faculty to business partners and the local community. An overall analysis of the impact of UBC reported in our US and Finnish case studies, two broad types of impact can be identified. First, an ‘internal’ impact on the university, faculty and students, where a further distinction can be made between an impact on the university, arising from commercialization of university research and technologies and the revenues it generates to the university, especially through patents, licenses and own start-ups, and an impact on faculty and students, especially in terms of student employability, new research ideas and real-life cases for teaching purposes for faculty. Secondly, an 'external' impact on the local and state economy, manifested especially through the jobs and tax revenues for the local economy, as well as the contribution to the birth of new industries and the societal impact of universities regionally and nationally.

Based on these observations, the following **recommendations** can be made for strengthening UBC:

- *Consolidate a university-wide innovation and entrepreneurship ecosystem* and build the capacity to provide problem-solving and creativity to broad range of industry partners;
- *Adopt UBC as a strategic institutional policy* aimed to strengthen both education and academic research and create important revenues for the university and the local or national economies;
- *Acknowledge both education and research as development paths for UBC* - UBC can be performed across a board spectrum of institutions and disciplines, ranging from research-intensive universities to more technically-oriented ones. Universities with a stronger focus on their education mission can also be successful entrepreneurial players by providing high-quality entrepreneurial education and training, new forms of experiential learning that give students higher grades, greater engagement in learning and better opportunities on the job market. Both education and research can be good starting points and development paths for achieving UBC, and are not mutually exclusive. On the contrary, they need to be pursued together in order to consolidate the Knowledge Triangle between education, research and innovation;
- *Diversify funding sources and adjust fundraising strategies accordingly;*
- *Hire people with business experience, especially in the offices working at the university interface with business, and provide specialised training courses for technology transfer managers;*
- *Increase the participation of business representatives in universities governance and in teaching and entrepreneurship education, curriculum development*, etc.;
- *Develop a regulatory environment conducive to UBC and provide more career incentives for academics and for students* (e.g. financial incentives for faculty and recognition of entrepreneurial achievements among their promotion criteria, company placements and internships, recognition of students' work experience for qualifications);
- *Ensure management of conflict of interest (e.g. by introduce clear conflict of interest rule)s and of expectations on both sides of UBC,* taking into account

the development stage of the cooperation and the slower pace of change in academia than in companies;

- *Gain further understanding of the complexity of UBC*: introduce regular two-way communication and flexibility and capacity to adapt to changing situations, stimulate the spirit of cooperation instead of diverging over diminishing resources;
- *Introduce clear goals and metrics for UBC, and monitor progress;*
- *Disseminate information on the potential benefits of UBC and promote a greater social acceptance of the "entrepreneur" and the culture of entrepreneurship*. While failure in an entrepreneurial endeavour ("the culture of failure") is recognized in the US as a normal part of the development of a business and as a part of a learning curve, and is even celebrated in highly entrepreneurial environments like Silicon Valley ("fail early and fail cheap"), Europe has a much less tolerant attitude towards business failures. The financial clearance after a business failure is much more costly and time-consuming and the 'stigma" of the entrepreneurs that have failed can often be long-lasting.
- *Foster the relationship with the local community and the contribution of UBC to the regional economy*
- *Allow sufficient time for the growth and accumulation of UBC effects and for the impact of certain policy measures.* For example, may people in Finland considered that the University reform of 2009 was too dramatic, that is should have taken place more gradually and thus avoid multiple side effects.
- *Adopt a global and future-oriented perspective for UBC*, which should take into account the challenges of globalization in higher education and research, and be reflected in the university research cooperation objectives, education and the provision of training and services abroad.

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Models For Academic Entrepreneurship: Canalside Studios Case Study

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Abstract

In 2005 the University of Huddersfield launched an in-house computer games studio, Canalside Studios. Funded by the University, the Studio was created to provide work placement opportunities for students studying computer games (programming and design). The Studio team is made up of undergraduate students and is supported by members of academic staff. Having had no prior experience of commercial game development the academic staff team recognised their own need for new learning and development around business awareness and industry issues to match the needs of a commercial studio. This process included the development of the staff through MBA and Enterprise Fellowship programs, industry guidance and practical project and team management by the academic staff of the Studio team. This on the job training provided an effective “Enterprise Apprenticeship” for the academics involved which has influenced a change in approach and practice and subsequently led to greater success in enterprise activity and industry engagement.

This paper provides a case study exploring the academic staff’s own development and increased understanding of industry partnerships and issues. It then presents models of academic enterprise developed through the Studio and discusses this as a distinct enterprise ecosystem.

The study reveals diversity in academic approaches to enterprise and commercial engagement within the institution and novel responses by academic staff to undertake personal development and training and define new models of working to support activities on the academic/industry boundary.

Although the study shows that there are many models for academic enterprise and entrepreneurship we conclude that academic entrepreneurs seek to take advantage of perceived opportunities and will persevere and adopt personally effective modes of work that may be outside the institutional norm.

Keywords

academic, entrepreneurship, enterprise, industry engagement, personal development

1 Introduction

The overarching mission of Universities is the generation and transfer of knowledge - in principle knowledge creation through research and knowledge propagation through publication and teaching. The academic community generate this knowledge through the foundation of Mode 1 and Mode 2 research (Gibbons, 1994) generating outputs ranging from new concepts and theories to new methods of implantation of technologies. Studies tend to be lab or experiment based, rigorous, theoretical or experimental in nature. The traditional output is through journal publication and the embodiment of the knowledge into the relevant curriculum.

The role universities play in economic development has been emphasised in recent years with university research and enterprise leading the way in the development of enterprising academics within the Higher Education Institutions (HEIs)(Cable & Willetts, 2011; Cox, 2005; Lambert, 2003; Wilson, 2012). "Academic Entrepreneurship" refers to the endeavours undertaken by universities and industry partners in the commercialization of their work (Wood, 2011). In the UK this has been led by government policy and appropriate funding priorities (Brennan *et al.*, 2005) and in recent years the global financial crisis, the state of public finances and the shift in government funding priorities have given academic entrepreneurship and enterprise an increased impetus. Scholars argue the appropriateness of academics managing commercial activities while engaging in an academic mission of knowledge production and transference (Lacetera, 2009). Academics approach to commercialisation of research differs in its priorities to industry's, with peer review and publication being high in the list of priorities, this may have led to additional non-commercial activities or less effective methods being employed. Lacetera (2009) that academics can be more selective in which projects they participate in or bring to commercialisation, making it worthwhile to disrupt their traditional activities holds true in research. The creative enterprise activities are more inline with industry, where ideas need to be commercialised within cost and on time. Some scholars view Academic entrepreneurship as an area where the scarcity of research highlights the dived between entrepreneurs known to the institution and latent entrepreneurs who are unsure whether their research is entrepreneurial and concerned over who has ownership and how to protect or use it. (Tidd *et al.*, 2005)

The case study presents a non-traditional approach by two academics to build a commercial computer game studio (enterprise) within a university (non profit enterprise) to both educate and develop within their institution. This case study presents what the academics phrase an "Enterprise Apprenticeship" as with all apprenticeships there is a theory and practical application.

The study uses a qualitative, sense making methodology based on a single case study and empirical evidence from within the institution. The main study is based on interviews with the core staff undertaking the enterprise pursuit and an open forum of eight academic staff. The interviews are used to profile the academic entrepreneurs approach to self-development and their insight into working with both industry partners and academic colleagues on multiple projects and the open forum on embedding enterprise. The authors recognise the limitations of a single case study and further studies will involve multiple parties from across academia and industry, to verify models and best practice.

2 Case study

In 2003 the University of Huddersfield in the Department of Informatics validated two new degrees in the applied field of computer games. The degrees were based around the three pillars of games development, programming (technical), design and art. As a response to the needs of undergraduate degrees within the University to offer a sandwich year the department set up an in-house computer games studio, Canalside Studios. Five academic staff from the course teams were tasked, though subsequently only two members of the team took the studio through to fruition and publication of their games.

The two academics had no enterprise or commercial computer games development experience. They had no Ph.D., no traditional research and no knowledge of enterprise. The studio was initially seen as an alternative to the traditional research led activities within the University, however the University had no formal mechanism for training and developing of academic staff who wished to engage in enterprise activities. The academics involved are self-taught and knowledgeable in software and art asset development for computer games.

Working relationships between academia and industry had to be developed and initially games companies were only willing to contribute to the curriculum. The ‘Industry’ perception of the Studio was that it was a foolhardy endeavour with limited chances of success for such an inexperienced team, they reasserted that institutions could teach the theory; yet there is no substitute to making a game and hands-on experience. Interactions between industry and the University took the form of informal meetings where mainly curriculum was discussed, industry were invited into the newly formed studio to hear the students ideas. Spillover from these events allowed both the students and staff to make more informed decisions. In the early days of the Studio, the students presented and developed short ideas for prototyping; several of the ideas were then developed. The increased confidence of the undergraduates led to the success when a game prototype was entered into Microsoft Dream Build Play competition in 2005. The competition attracted over 3400 entries from HEIs through to individual and independent developers, the entry came 2nd and the reward was a development contract with Microsoft to release an arcade game on the Xbox platform. The University was content with what was seen as useful publicity and recruitment, the students were ecstatic, the staff were content for all parties but concerned at the implications. It was clear that the staff would need developing, the Studio would need developing and industry help and guidance would be required to ensure that the arcade game development project succeeded.

2.1 Staff Development Journey

2.1.1 Staff member 1

This member of academic staff had been with the University for 5 years. With an engineering background and first-degree, his experience was in software development and teaching. As an engineer he was trained in problem solving and had undertaken a placement year during his studies and believed in the value of industrial experience. The challenge the Studio offered was an attractive alternative to the traditional academic apprenticeship of research and Ph.D. Having had no managerial or business experience, the academic decided to commence with an MBA as an alternative to staff development. Colleagues saw the MBA as a route to strong management and business skills. MBAs as Mintzberg (Mintzberg, 2005) argues do not necessarily make good managers, managers require experience insight and analysis. The modern MBA program is designed for people with little experience or craft to draw on. The MBA develops the student in a broad context and is summarised in the table 1.

Marketing
Ethics
Accounting
Organisational behaviour
Quantitative analysis
Finance
Operations
Economics
Strategy

Table 1 MBA Specialities

The MBA being broad did not enable the academic to fully grasp the games production cycle and the creative side to the enterprise, it did however allow the academic member of staff to seek promotion coupled with the newly formed Studio. The MBA built confidence and appreciation of business opportunities for greater insight into management and was useful in providing direction and leadership within the Studio. Upon successful completion, the MBA opened new doors with direct synergies to the Studio and the University strategy of growing research. He made a successful bid for a 'Yorkshire Fellowship in Enterprise'; each fellow received a budget of £10000 to support their research, a tailored training programme and business mentor for the duration of the fellowship. The business mentors were academics who had successfully commercialised their research. In this instance the business mentor was a specialist in medical simulations and serious games. Fellowships were awarded on the criteria of, quality, novelty and commercial value together with the fellow's drive and enthusiasm. Quarterly review meetings were held with the mentors.

The University required a strong research output from the Studio although the Studio's function is to design and implement games, currently for Xbox, with little potential to spin off academic research. Therefore the Studio had to look at alternative approaches the fellowship provided. The project was in the form of a serious game, a simulator to train podiatrists. The system would use a haptic device to simulate the use of a bone saw that would allow the surgeon to implement virtual operations. This research led to Masters of Research (MRes) qualifications for the two students involved. A paper was presented at conference that detailed our different approaches to cutting of a 3-D mesh and the re-formation of the polygons within that mesh (Boothroyd *et al.*, 2012). The fellowship fulfilled the task of aligning the Studio output with the University strategy of a stronger research focus.

The fellowship provided the formal training required to translate academic research into commercially viable opportunities and the strategic funding to stimulate entrepreneurship within the academic environment. The fellowship gave the academic a strong understanding in the following areas, table 2.

Markets
Intellectual Property (IP)
Funding streams
Management
Business methods
Entrepreneurial skills

Table 2 YEF Specialities

The staff member followed this training with a more structured management-training programme organized by the University the Academic Leadership Programme (ALP). The course introduced skills in the following areas, table 3.

ALP - Change Management
ALP - Managing Challenging Behaviour
ALP - Negotiating and Influencing Skills

Table 3 ALP Specialities

2.1.2 Staff Member 2

Staff member 2 had an MA in Art and Design and an MSc in Digital Media. With experience of working in the Arts and as a freelance designer prior to teaching in Higher Education (HE) she brought a creative skillset and experience of interdisciplinary working to the Studio project. With teaching specialisms in concept development, design and

3D she was tasked with providing direction to the creative members of the Canalside student team.

As a member of staff without a PhD access to resources and facilities to support early stage research were limited and the Studio provided an opportunity to engage in creative practice with a committed student team and dedicated resources and with a high degree of autonomy. The benefits of involvement in the Studio were that it would be potentially career enhancing, since it could show evidence of higher level practice than would be possible in the normal teaching environment and industry engagement and give personal satisfaction through the creative contribution.

Having both creative and technical qualifications the staff member identified the need for further development in business and leadership skills and undertook University training through the Academic Leadership Programme (ALP) and an MBA (as a part time student).

Some difficulties were experienced in managing work with the student team in the first stages of the Studio development, as the transition from teacher to manager was not easy. As a teacher used to encouraging and developing students and with an informal style there were problems in projecting authority. It became evident that the approach of asking a student to do work was not sufficient since this could be construed as merely giving advice or making suggestions that in the classroom situation students could choose to ignore. In order to overcome this it was necessary for the staff member to adopt a more aloof position and to be very direct when giving instructions and setting out expectations. Although the structured development of the ALP and MBA programmes were useful in providing insight into the broader context of business processes and work, the more subtle skills of learning to manage a team and confidently instruct and direct work were acquired more slowly by experience and through informal observation of other managers to understand both good and bad practice and the personal testing that determines a comfortable personal style that works.

Having recognised the required development table 4 highlights the routes taken on their formal training or academic enterprise apprenticeship.

Skill / Capability	Development Route
Project Management	MBA / YEF / Practice
Business Knowledge	MBA / YEF / Microsoft
Leadership	MBA / Academic Leadership Programme (ALP)
Game Development Cycle	Microsoft / Industry Colleagues
Client Management	MBA / Practice / Reflection
Enterprise Development	Reflection / Practice / Industry Colleagues
External Presence	MBA / Networking / Social Capital
Research Supervision	MRes / PGCert HEP / Published Work
Marketing and Sales	Marketing and Sales

Table 4 Academic Enterprise Apprenticeship (Skills & Capabilities)

2.1.3 What is entrepreneurship?

In Gibb's (1988) The Enterprise Culture: Threat or Opportunity? He defines Entrepreneurship as

> *"The exercise of enterprise attributes in any task or environmental context"*

and an entrepreneur as

> *"Someone who demonstrates a marked use of enterprising attributes, usually in commerce or business"*

Enterprise Attributes
Initiative
Strong persuasive powers
Moderate rather than high risk-taking ability
Flexibility
Creativity
Independence/autonomy
Problem-solving ability
Need for achievement
Imagination
High belief in control of one's own destiny
Leadership
Hard work

Table 5 Gibb's Enterprise Attributes

There are many definitions of entrepreneurialism a contemporary view of Professor Howard Stevenson of Harvard Business School in 1975 defined entrepreneurialism as

> *"Entrepreneurship is the pursuit of opportunity without regard to resources currently controlled" — a widely regarded definition Harvard Business School professor Howard Stevenson, D.B.A., first coined in 1975*

Clark provides a different view of entrepreneurialism in the context of HE.

> *Clark (Clark, 1998) "An entrepreneurial University, on its own, actively seeks to innovate how it goes about its business. It seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. Entrepreneurial universities seek to become 'stand-up' universities that are significant actors on their own terms"*

The two definitions have quite a different character. Stevenson emphasises the risk-taking aspect and Clark the innovation aspect.

From Gibb's and the above definitions it could be argued that the business and commerce of Higher Education is Education, Research and Enterprise. Etzkowitz and Leydesdorff (1997) explore the knowledge economy and university-industry-government relations and their required contributions for success. They further discuss the development of new technology and knowledge transfer and use the notion of a triple helix of government, academia and industry to drive innovation they argue that the triple helix provides a model for both knowledge creation and transfer (2000). According to Steve Fuller (Fuller, 1999) the first example of a triple helix institution was the Kaiser Wilhelm Institute in Germany in 1911 funded jointly by the state, international industry and universities.

2.2 Industry engagement

It was recognised that industry engagement would be critical to the development of an enterprising environment within Canalside Studios. This was achieved through the use of industry gurus and a commercial producer-publisher relationship with Microsoft. What did Industry Guru bring to the Studio? He brought tacit knowledge having worked for twenty years in the industry and on major titles. His career had culminated in a directorship at a major developer and publisher. He was a very strange character to get on with yet he had the knowledge of how to make computer games. He would challenge the publisher's requests. He had the knowledge and reputation to question publishers, where the academics with no knowledge of games development were anxious about the relationship with the publishers and initially believed the publisher must lead the development. Industry guru disagreed and opted to leave the project 75% through the development, the main disagreement was the requirement for the game to have a single player mode, this was not the core of the game and the guru felt did not add to the game play. Microsoft disagreed and insisted on implementation, a clash of titans.

What did Microsoft publishing bring, Microsoft brought compliance, industry specific business practice, coupled to the academics own development quality assurance, localisation, planning, art styles and art bibles, technical guides, technical requirements, testing and working practices to the Studio.

Both parties brought knowledge to the Studio one corporate (Microsoft) and one independent and practical (Industry guru). Given the gaps in knowledge and a need for the Studio to innovate and add value and complete the product to a professional standard, tacit knowledge needed to be transferred. Quinn *et al.*(1996) propose how knowledge growth is exponential when shared and can be of greater benefit to companies that learn from outsiders - especially from customers (Microsoft), suppliers, and specialists (industry guru).

2.2.1 Working practice

Students, when questioned, normally only work about 20 hours a week on average here we were asking the students to work 35 hours a week. Industry colleagues suggested that the student should actually work weekends to ensure that the game was delivered on time and milestones were met. Industry colleagues were clear that if the Studio was to replicate a real game studio and be a valid experience then the workload and hours present should be comparable. For example the Studio experimented with flexitime, and open casual office, this did not work. There was a lack of dependability and trustworthiness between the Studio team.

The students needed clear management; working in a commercial studio within a University environment required a cultural shift, and greater maturity, from the students. Asking for help when required and checking on colleague's progress was a key skill. For example one of the team tasked with the games network design was left unchecked for 6 months, when crunch came the game network did not perform, which led to retrofitting the network to the game engine. A good line of communications and meetings build trust and respect within the team and prevent future problems.

2.2.2 Trustworthiness and dependability

Colleagues need to be taken at their word and reputation to ensure the job is done. Trustworthiness exists when two or more parties sign a formal agreement or contract, even if this means that your partners may have to back you when things go wrong. Microsoft offered to assist with additional artists to finish the assets in time to make sure that the studio hit their Alpha.

2.2.3 Teamwork

Studios function on their teams. A good team is where all employees want to work together and want to problem-solve and find solutions. Under certain circumstances teams need to break down behavioural barriers, for example a member of the team with poor work ethic. Participation is crucial, everybody participates, we win as a team, or fail as a team.

Due to the studio being staffed by third-year undergraduates on their placement not all the training and education had been fulfilled therefore the students also needed an independent yet managed approach to training.

2.2.4 How did industry perceive the studio?

Industry was very supportive of the studio from the outset with a view that to understand games one must make a game. Textbooks can take you through the process but cannot take you through the pain. Practitioners talk about, going through the test, about hitting technical requirements, and dealing with publisher asking you to redo items. Even though there is a design plan, the document is fluid in its nature; the way it treats the game changes as the game itself develops. This is expected and can have planning and resource implications. Hence, Microsoft offered additional support to the Studio to complete their Alpha on schedule.

One of the problems with dealing with Microsoft was a timing issue. Microsoft UK did not have the Xbox division, Microsoft US did; an 8-hour time difference between the two locations. A standing telephone call or appointment was made weekly with Microsoft. The Studio would go through the progress of the game, any complications with the game anything that may lead to delay and any support that Microsoft could offer an initial handholding procedure until the Studio had the necessary knowledge. For example the University is a not-for-profit organisation and does not have liability insurance to cover for example an epilepsy attack caused by the game $1 million per case, required.

The Studio needed to be secure, this didn't just mean a physical lock, this meant from all possible forms of attack Microsoft made an investment into the game studio and would be placing their development kits with a nominal value of $10,000 at our disposal. These kits allowed access to all other games that were under development for Xbox Arcade at that time. This is sharing best practice and requires a high level of trust between all participants; the Studio needed to prove its trustworthiness or risk souring this important relationship.

Part of establishing trust was entering into a non-disclosure agreement (NDA). The University signed an NDA initially with Microsoft so we could discuss our ideas. An NDA allows parties to communicate openly. Few NDAs are assigned in academic research where publication entails information disclosure. Where industry collaboration and involvement is required or needed then an NDA must be negotiated.

The University wants a strong research output from Canalside Studios, while the Studio's job is to design and implement games. One approach taken was in the form of serious games. The 1st attempt was a tool to train podiatric surgeons. The system would use a haptic device similar to a bone-saw that would allow the podiatrist to implement virtual operations. A serious game is not formal training and would not be counted as additional work for the podiatrist. This research led to 2 masters of research qualifications for the students involved. A paper was presented at a conference that detailed our different approaches to cutting of a 3-D mesh and the re-formation of the polygons within that mesh utilising a translational research approach (Boothroyd, *et al.*, 2012; De Luca & Taylor, 2012a)

The University provided the initial seed funding to establish the Studio, this was followed by collaborative venture funds with numerous partners and EU funding for researchers night. So long as the Studio made independent games and did not try and take business from the local companies, no conflicts would exist. The regional trade organisation (Game Republic) insisted that a contract be signed to establish Canalside Studios as non-locally-competitive. Making games does not come within the normal remit of the senior lecturers role within the University, yet it is similar to the publication of research, with commercial potential through game sales and reputation. Also, members of academic staff are full-time employees with responsibilities and commitments to the School and University. To manage this issue the University itself signed the commercial deals and the NDA's. This also ensured that the University was happy that academic staff could abide by its policies and employment practices while fulfilling their commercial obligations.

An interesting potential conflict-of-interest in intellectual property generation emerged from the status of the students working in the Studio. The students are not employees of the University but are awarded a bursary for placement study to cover living costs. Under the university's IP regulations undergraduates own their work. An exception to the usual IP regulations was made here ensuring Canalside Studios was clearly mentioned as owning all IP unless the idea had been signed away to a partner organisation.

2.3 Enterprise ecosystem

Since the initial success the Studio has explored various interactive media value chains through a range of projects including: - interactive books, health promotion and an European Union funded International Researchers game, with the brief of explaining to 7 to 15 year olds that a university does not just engage in teaching. The Studio has worked with a varied selection of partners from the Royal Armouries through to the Fire Service. Whilst the Studio's main focus is on academic entrepreneurship, enterprise and commercial experience for the entire team it has a unique position within the University. The Studio has been providing an effective interface facilitating three-way knowledge exchange between students, academic staff and the games industry partners. This exchange facilitated the aforementioned projects and the translational approach of cross-disciplinary research feeding through to product. It could be argued that Canalside Studios creates an environment with an increase in entrepreneurial spirit, skill and support or an enterprise ecosystem in its own right, a community of interacting scholars and practitioners with a shared resource environment dependant on each other's success.

The ecosystem has benefited industry colleagues and academic colleagues from across campus and beyond. The evolving ecosystem has led to the integration of entrepreneurship and innovative pedagogies, alumni entrepreneurs and spin out enterprises.

Stakeholders bring different perspectives to a project; universities and industry can learn from each other, knowledge transfer facilitates the development of innovative new products, processes and services, the dissemination of ideas, and the stimulation of engagement between the wider society and the research and enterprise communities. Knowledge transfer may be a two-way exchange however both parties must realise that this is not always an equal exchange. To ensure all parties benefit, as a simple rule motivation and reward mechanisms must be in place and processes must be managed and evaluated in a timely fashion, then trust, and therefore bridge building, will develop. Entrepreneurial academics do not require complete academic change, it is possible for them to maintain their research and teaching activities and in the best cases the enterprise, research, and teaching form a natural synergy.

2.4 Models of enterprise and entrepreneurship

The Canalside Studios case study led to the development of the 'Enterprise Apprenticeship' model shown in figure 1. A non-traditional approach to enterprise and research through an environment facilitating knowledge generation and transfer at all levels. The academic recognised a shortfall in skills and knowledge and through a combination of both formal and informal development filled any shortfalls.

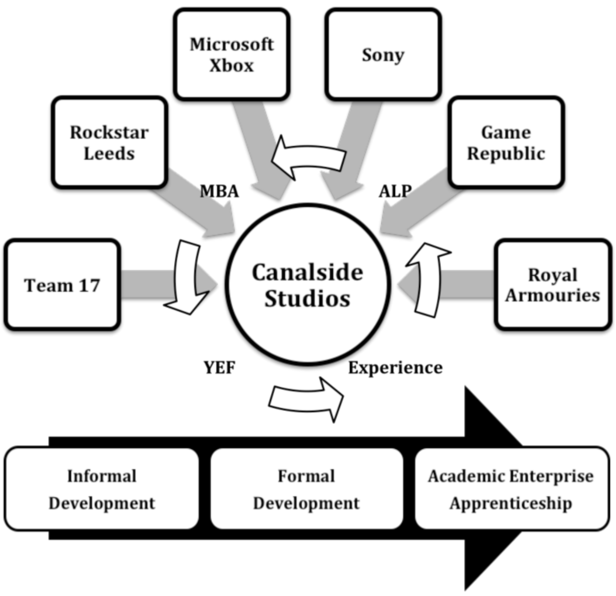

Figure 1 The Canalside model

These academics fall into the 'Academic entrepreneurialism' zone as shown in figure 2 adapting their behaviour and skill set.

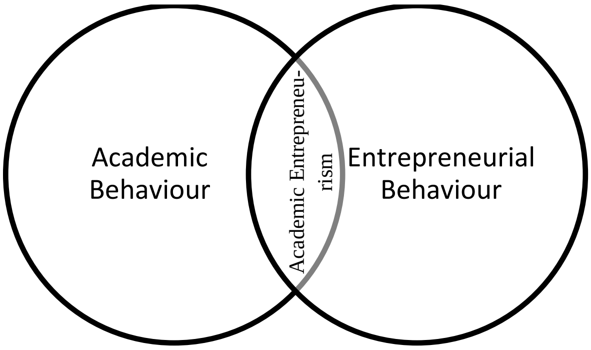

Figure 2 Academic verses Entrepreneurial Behaviour

A generic version of the above case study model of the enterprise apprenticeship is shown in figure 3. The informal development is drawn from both academic and industry experiences and social capital. A continuous improvement methodology to formal development is required leading to enterprise outputs through a suitable vehicle, i.e. studio, laboratory and or research groups. It is the intention of the authors to further investigate and validate the models presented in this paper.

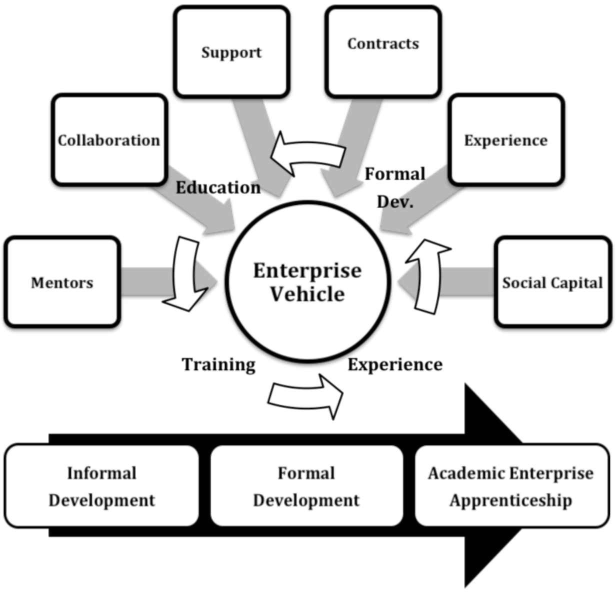

Figure 3 Academic Enterprise Apprenticeship model

Given the definition of entrepreneurship and academic entrepreneurship and the arguments presented, academics at the pinnacle of their field it could be argued are already entrepreneurial and need institutional support and persuasion to commercialise this experience. Hay *et al.* (2002) suggest the difference between academic and entrepreneurial behaviour are not so distinct, a key difference being attitudes to risk-taking. The traditional academic being generally more risk averse and therefore the nature of the work environment may be significant. Etzkowitz (2003) states that in research universities, research groups function in a firm-like way and share many of the qualities of a start-up company so the transition from academic to enterprise culture is less difficult and this may support spin out activities. From the literature presented and empirical evidence within the University unauthenticated models of enterprise have been recognised (De Luca & Taylor, 2012a, 2012b). The most traditional model in figure 4 shows the traditional academic approach of research council grant and publication, no enterprise consideration.

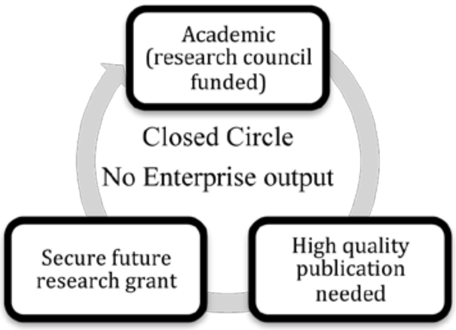

Figure 4 Traditional Research model

Academics or teams are funded through research council grants. The predominant result is publication, peer review and prestige. It should be noted that certain research calls and grants require collaboration and a commercial partner and output as shown in figure 5.

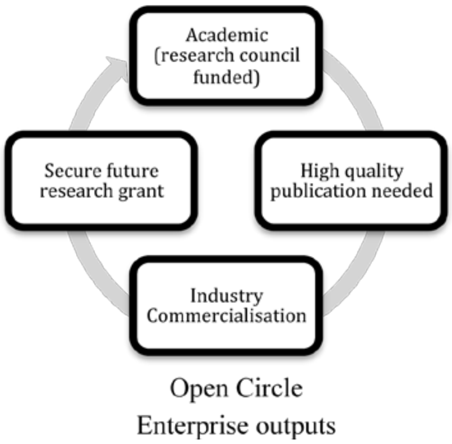

Figure 5 Collaborative Research model

Variations on the industry collaborations provide a triple helix approach to research where industry, government and the university partner in funding and collaboration, figure 6.

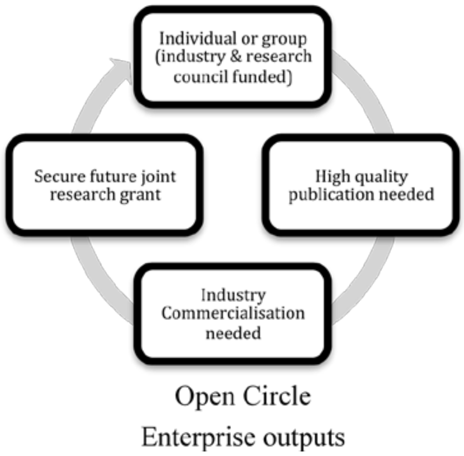

Figure 6 Triple Helix Research model

A more entrepreneurial academic may seek to exploit IP arising from their academic research. Here the commercial partner may be found independently of the research council funding. The academic is not only interested in prestige; they are interest in commercialisation, figure 7.

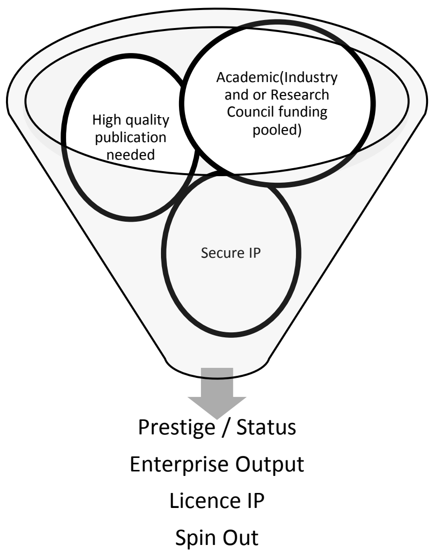

Figure 7 IP / Patent Enterprise Income model

A fifth model identified academics or teams who prefer non-government support for their research. Discussions with these academics found they referred to this type of enterprise activity as 'real world research' solving industry problem, figure 8.

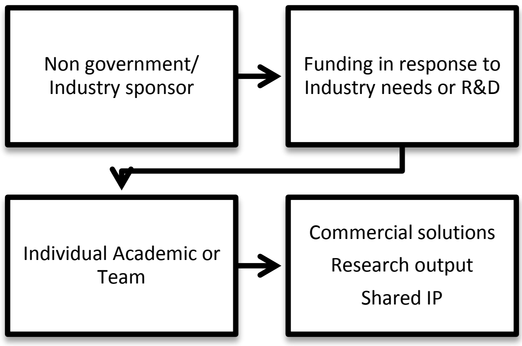

Figure 8 Industry Sponsored Research model

Figure 9 shows the domain of these academic entrepreneurs adapted from Brennan *et al.*(2005) as staff, business and enterprise awareness increases the classroom and studio environment becomes more open/permeable to business and enterprise opportunities, ideas and ways of working. Scholars suggest that there are tensions within higher education between academics who see themselves as protecting traditional academic values and an organisations changing mission to contribute to economic growth through increased enterprise activities, paid for research or spin out activities (Philpott *et al.*, 2010; Rinne & Koivula, 2005; Williams, 2002) In certain areas of academia it is clear that entrepreneurial activity is more prevalent for example biosciences, engineering and technology subjects and where collaborative partnerships with industry or external partners are more likely (Belcher & Trowler, 2001; D'Este & Fontana, 2007; Martinelli *et al.*, 2008).

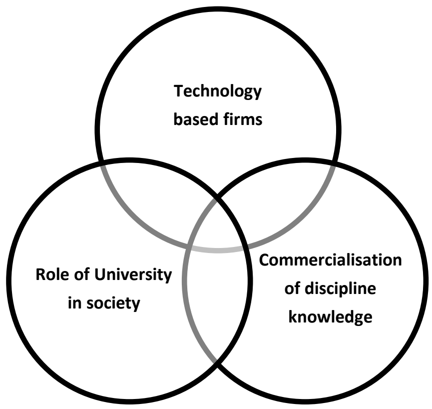

Figure 9 The Domain of Academic Entrepreneurship

Within the domain of Academic Entrepreneurship it has been recognised that both one-time and habitual entrepreneurs reside. Habitual academic entrepreneurs are either serial, single venture at any one time or portfolio, many ventures simultaneously (Ucbasaran *et al.*, 2006), it could be argued that the majority of professors who lead research groups share similar attributes and characteristics and fall into this category of academic entrepreneur. These academics identify opportunity and have the necessary human and equipment resources to ensure performance and subsequently move onto the next or parallel venture.

Brennan et al. (2005) recognises four clear types of academic entrepreneur from a selection of nine academics across different disciplines. In this paper a further type has been identified of the ‘Enterprise Academic Apprentice’ – a highly social non traditional academic with a strong focus on inter-disciplinary knowledge applied to problem solving, a strong focus on self improvement and continuous development, with a thirst for creativity. Willing to work with both internal and external networks without regard for formal structures within the University and a flexible approach to current resource control, this type of academic generates discipline and enterprise knowledge and propagates this through enterprise, research and teaching.

3 Conclusions

The current and future roles universities play in the nation’s economic health is being made clearer through government policy and funding. The role of universities in knowledge production and dissemination requires a shift from traditional teaching and learning to a triple pronged approach of Enterprise-Research-Teaching. Government and industry need to ensure that the future funding requires full collaboration to ensure success. To this end the authors believe that industry engagement and a triple helix approach to collaboration is essential. Academic Entrepreneurs can help led this industry engagement and are capable of operating at the boundaries of academia and industry through specialised studios or research facilities.

Modern universities need to ensure that their enterprise-enabled staff are supported and developed. New courses and staff training need to be introduced and senior managers need to support their entrepreneurial staff. A cultural change from a fully research led university to a research and enterprise university needs to prioritise and suitable strategies to enable staff and remove barriers.

Institutions need to enable working relationships between industry, government and the institution that go beyond curriculum design and one-off research and foster long term working relationships that enable a two-way transfer of knowledge and working practices.

We have presented models of enterprise and entrepreneurship recognised throughout the University and proposed an addition to Brennan *et al.*(2005) work on Academic Entrepreneurs and introduced the ‘Enterprise Apprenticeship’ and self-development model. These academic are prepared to adapt and adopt differing modes of working.

The case study has highlighted the need for a training or mentoring approach to staff development that can be coupled with more traditional methods and education. Many academics show entrepreneurial characteristics and many will be latent or covert entrepreneurs. It is essential that these academics be nurtured.

Institutions can approach this new paradigm in Higher Education and have the capability in-house to do so. A shared experience has brought new working practices and developed working relationships leading to innovation and enterprise outputs; all parties benefit from the journey. The Studio has introduced opportunities that would normally only be afforded to competent experienced staff.

In response to this case the researchers intend to: -

- Fully access the extent of enterprise activities undertaken within their institution and develop models to support the various approaches taken.
- Validate these models with external colleagues across the HE sphere.
- Explore the nature of academic entrepreneurship and the extent that the academic entrepreneur is supported.
- The authors hope that by recognising different models of enterprise and entrepreneurship, the transition from a teaching and research university to a more commercially minded university will be more straightforward and rewards reaped earlier.

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Interactive Learining In SME-University Collaborations: A Conceptual Framework For Facilitating Interaction

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Abstract

There is a perceived gap between firms and universities. The great majority of SMEs in Denmark do not collaborate with universities; however, firms benefit from collaborating with knowledge institutions. The case presented in this paper, Shortcut to new knowledge, is a programme attempting at narrowing the gap by providing a platform and funding opportunities for SMEs to collaborate with academic researchers in innovation projects. An operator located at a university facilitates the collaboration between SMEs and academic researchers in the experimental programme for knowledge-based innovations. The facilitation process focuses on interactive learning and is divided into phases, which makes it easier for SMEs to progressive engage in innovation projects with researchers. In-depth interviews with the facilitators of the programme were conducted and focused on barriers to collaboration, human interaction, and lessons learned. From the facilitators' perspective, a conceptual model capturing the main actor's activities in each phase paralleled with an illustration of the narrowed gap from the human interaction is presented in the paper. The main findings addressed the issues of human-based and system-based barriers. One of the lessons learned is the importance of human interaction of narrowing the perceived gap by mitigating the human-based barriers, and to some extent also system-based barriers. The case presented in this paper has managerial and innovation policy implications.

Keywords

Interactive learning, SME, barriers, innovation, facilitator.

1 Introduction

Firms benefit from collaboration with knowledge institutions, including universities or other research institutes (Turpin et al., 1996; Etzkowitz and Leydesdorff, 2000). Cooperation with universities generates sales of innovative products and services novel to the market; thereby improving growth performance of firms (Belderbos et al., 2004). It has been recognised that small and medium-sized enterprises (SMEs) are important actors in creating, applying and introducing innovations in local economies (Curran and Blackburn, 1994). The majority of firms in the Danish economy are SMEs, approximately 97 per cent; however, only a small fraction of the SMEs collaborate with knowledge institutions. As a matter of fact, merely five per cent interact, or stated otherwise, 95 per cent do not collaborate with universities.

This signals a great gap between potential benefits of university-industry interactions and the unexploited opportunities of value creations for small and medium-sized firms. Some of the universities in Denmark offer services to firms, including matchmaking and technology transfer. The universities' 'third mission' or successful transferral of scientific findings into commercial development (Readings, 1996; Etzkowitz et al., 2002) is hardly accomplished through Danish SMEs. The case presented in this paper – Shortcut to new knowledge – initiated by the Central Region of Denmark and facilitated in cooperation with Aarhus University is an exploratory project managing a phase-divided programme for SME-university collaborations. The objective of the programme is to create knowledge-based innovations through the process of 'interactive learning' (Lundvall, 2010a). Improving the SMEs capability to learn from interacting with an external knowledge source would, arguably, increase the absorptive and innovative capacity of the organisation. Creating knowledge by the process of interactive learning will eventually affect the organisation's ability to discover innovative solutions and be incorporated as an important ingredient to future success.

This paper focuses on the perceived gap between university and industry with a special attention to human- and system-based barriers. Interactive learning is a human activity and is based on relations, including complementary competences and matching personalities for successful innovation collaborations. A conceptual framework based on the experiences from a group of facilitators of SME-university interactions illustrates the phase-divided approach of coordinating collaborations between SME and academic researchers. The conceptual framework is inspired by the stage-gate system (Cooper, 1996) and model for innovation phases (Myers and Marquis, 1969), as well as applying phases of facilitation (Minahan et al., 2009). The main actors' activities at each 'gate' and 'phase' is briefly outlines in the framework and discussed in the section 'main findings'. The framework has managerial implications for the coordination and planning of university-industry collaborations. The narrowing of the perceived gap through human interaction and communication is exemplified in the framework.

A literature review on selected themes related to the case is presented in section II. Methodology is described in section III, followed by the main findings from the case in section IV, including programme structure, implication of barriers, main lessons learned, and the conceptual framework. Section V is the discussions of main findings and section VI with conclusions.

2 Literature review

The literature comprehends areas of interactive learning processes, relationships, barriers to collaborations, knowledge diffusion from external sources, inter- and intra-organisational communication, absorptive capacity and organisational learning; elements of the human interaction constituting the processes that lead to innovation. One of the major contributors to the innovation literature is Lundvall and his perspective on innovation as an interactive learning and socially embedded process. With the assumption that knowledge is the fundamental resource in a modern economy, then the most important process is learning (Lundvall, 2010a). 'Searching' and 'exploring' results in learning; firms conduct a profit-oriented search, whereas universities' less-goal-oriented exploration is the raw material for the process of innovation (Lundvall, 2010a). New, recombined or rediscovered knowledge introduced to the economy is called innovation, and innovation may be viewed as a collective activity, which is an outcome of communication and interaction between people (Johnson, 2010).

Lundvall states the implications of interactive learning:

> *An 'innovation as an interactive process-perspective' brings two crucial new elements in the analysis. The first is, of course, uncertainty reflecting change and growing complexity. Innovation involves by definition the creation of qualitatively different, new things and new knowledge. Therefore agents involved in the creation and adaption of innovations cannot reasonably be assumed to know all the possible outcomes of their activities. (2010b; 48)*

The social aspect of learning is supported by Johnson:

> *Since almost all learning is done by some form of interaction, it is shaped by institutions. It is a social process. It is seldom done individually, without support of, or isolated from, interpersonal relations. (2010; 31)*

Interactive learning is a process of learning by producing, searching, and exploring. The pathway to innovation requires a stock of new knowledge, as well as creative forgetting existing knowledge; thus, knowledge is changed both by learning and by forgetting (Johnson, 2010). Johnson argues that "the role of forgetting in the development of new knowlegde has been underestimated" (2010; 29). New knowledge tends to remain uncodified and difficult to acquire except through hands-on learning; in order for knowledge to be easily transferred, it needs to be transformed into words and codes (Zucker et al., 2002). Zucker et al. argues that the importance of ties suggests that working jointly, or through interaction, at "the lab bench" is a crucial transfer mechanism when knowledge is an important or large tacit component (2002). Tacit knowledge is bound to contextual experience and thus a result of self-learning; explicit knowledge derives in part from context-related information into definable patterns and is transferrable if the medium of transfer enables the transferral of meaning (Iles and Yolles, 2002). Explicit knowledge and the process of storing and indexing, as stated by Iles and Yolles, is the aftermath of self-learning tacit knowledge or may have been received as knowledge transfer (2002). The process of knowledge migration, which is the movement of knowledge between the industry and university and is subject to redefinition every time it migrates (Iles and Yolles, 2002).

Innovation processes are dynamic, complex, and a result of cumulative interaction and learning processes involving many actors (Bessant and Tidd, 2007). Also collaborative relationships are dynamic in nature; the broker or intermediary has the role of providing a platform to enable the evolution of an on-going goodwill-based relationship rather than merely supplying 'contractual trust' for a single transaction of collaboration (Davenport et al., 1999). Brokers and facilitators of learning are using interpersonal, creative, and functional skills (Iles and Yolles, 2002).

The firms' capability to absorb knowledge from the external environment, the 'absorptive capacity' (Cohen and Levinthal, 1990), is an important factor for the organisation's ability to acquire new knowledge and diffuse it into the organisation. The individuals at the border of the organisation interacting with the external environment are the 'gatekeepers' (Tushman, 1977), and their role is to diffuse the knowledge from the external source into the organisation. However, the absorptive capacity of the firm does not constitute the cumulative capabilities of the gatekeepers but the whole firm's ability to use the new knowledge is key to organisational learning (Cohen and Levinthal, 1990) – and eventually the firm's survival in a changing environment.

In order for new knowledge to be developed, communication and information sharing between two or more actors is a part of the process. Confidence and trust are substantial elements of what is built up in the interaction, and what constitutes the relationship (Christensen, 2010). The importance of trust to overcome academics's barriers to collaboration is suggestive of the importance of human interaction and personal relationships in creating and sustaining links between industry and academics (Tartari et al., 2012); personal and professional experience is shaping the minds of academics and mitigating barriers to collaborate. From a firm's perspective, the barriers related to the differences in the orientations of university and industry are lowered by prior experience and breath of interaction, and greater levels of trust reduce both the transactional and orientation barriers to collaborating with universities (Bruneel et al., 2010). Trust will evolve incrementally, according to Davenport et al., from repeat relationships between the same partners (1999).

3 Methodology

The paper is based on qualitative methods in a three-step approach: first, a preliminary review on knowledge institutions' activities with private and public sector was conducted, followed by a case study on an experimental programme to explore the university-SME interaction for knowledge-based innovation in with a phase-divided approach to the process of collaboration. Finally, a conceptual framework for managing the university-SME interaction for innovation projects is developed from a facilitator's perspective.

The initial step to the identification of the case-based research of the programme Genvej til ny viden (in English: Shortcut to new knowledge; hereafter, this title will be applied in the paper) was a preliminary review study of the activities undertaken by the universities, academic and researchers in particular, for the interplay with firms. This review indicated evidence of the three main actors in a Triple Helix model (Etzkowitz et al., 2002) interacting on various levels for different purposes. The purpose of the review of secondary data – cases on university-industry interactions – with municipalities and regions as active contributors to the interplay between knowledge institutions and firms. The preliminary framework for screening of cases included parameters of identifying primary actors, method for interplay, main driver of the interaction, platform for interaction, time horizon, and value creation. The review with the preliminary framework as a lens to the screening of cases suggested a conceptual division of knowledge sharing at various levels, according to the 'gravity' of the knowledge shared and its possible diffusion into the interacting actors.

3.1 Preliminary review study

A preliminary review was conducted on secondary data with cases on university-industry interaction. The interpretation of the preliminary review of cases led to a division of knowledge sharing by its gravity into a 'funnel' illustrating the importance of knowledge, as knowledge moves down the funnel. First, platforms for half to full day arrangements for information sharing on topics targeted specific industries were categorised as 'low knowledge gravity', which could inspire the attending actors to new ideas. Secondly, networking and other matchmaking platforms with a relative short time horizon, or programmes with an expiration date, were categorised as 'medium knowledge gravity'. Thirdly, platforms supporting long term collaborations and relationships between actors for knowledge transfer and sharing, for instance cluster organisations and innovation centres, indicated 'high knowledge gravity'. This model has not been tested and is subject for further research on empirical data.

However, this preliminary review was the source of inspiration to identify a university-industry interaction, which was not considered 'regular practice' but rather an attempt of 'next practice' in the Danish context and innovation system; this programme is Shortcut to new knowledge. The classification of this programme is labelled as 'medium knowledge gravity' for the actors involved, in particular for the firms, as the programme has a time limitation of three years, which does not ensure a platform for university-industry interaction after the completion of the programme. The aim of the paper is to identify the facilitating process for innovations from university-industry interactions – a platform for long term and continuous collaboration. According to the preliminary model for knowledge gravity, the time limited programme would, arguably, move down the funnel from 'medium knowledge gravity' into the category of 'high knowledge gravity' is applied into the innovation system with long term implications.

3.2 Case study

An interpretive case-based research was conducted on the management of the SME-university collaboration from a third party – an operator anchored at the university – which is unprecedented in the Danish context. An information search on the Danish universities' websites did not indicate programmes for managing the overall collaboration processes between with SMEs and researchers, such as the case presented in this paper; many of the universities have services, such as matchmaking between firms and academics but none indicating an overall facilitation of the interaction process. The case-based research was conducted by including data collected from the midway evaluation report and other documents on the programme Shortcut to new knowledge, as well as in-depth interviews of approximately one hour length, and follow-up dialogues, have been conducted with four of the main facilitators of the programme, including the project managers and special consultants acting as 'the operator' of the university-SME interaction. The perspective of the case is therefore from the operator of the innovation process between the firm and researcher, and the validity of the interpretations was assured by receiving feedback from the majority of the interviewees.

The case-based research on Shortcut to new knowledge has a mixture of inductive and deductive approaches (Carson et al., 2001). The inductive approach is to incorporate an explorative dimension to the analysis while deducting or confirmatory dimension on theory and previous studies including knowledge sharing through intermediaries or brokers and building trust (Chesbrough, 2006; Davenport et al., 1999), interactive learning processes for innovation (Lundvall, 2010), absorptive capacity and organizational learning (Cohen and Levinthal, 1990), and addressing the barriers or gap between the industry and academia (Bruneel et al., 2010; Iles and Yolles, 2002; Tartari et al., 2012).

The interpretation of the content and concepts discussed in the four in-depth interviews with the experts are incorporated in the case study section. The in-depth interviews were recorded and the content was analysed to comprehend the meaning of the text and actions described by the interviewees (Ghauri and Grønhaug, 2005) with the source by Tesch' model on qualitative research types. The main focus of the interviews were the perceived gap between industry and academia, the factors indicating barriers or challenges, and how these could be reduced or overcome with the facilitation of the innovation process for university-industry interaction. As the preliminary review presented difficulties obtaining information on the value creation to the firms from the collaboration; therefore, the interviews were conducted to gain an insight to the dimension of possible value creation from the particular interactions in the programme by mitigating the barriers for collaboration.

3.3 Conceptual framework

A conceptual framework for managing an innovation process between researchers and firms is designed with inspiration for the stage gate model for product innovation (Cooper, 1990) and model of innovation phases (Myers and Marquis, 1969). The lessons learned are described and interpreted by the facilitators; thus, the perspective of the model is from the facilitators' point of view. The conceptual model is presented in the section of 'main findings'.

4 Main findings

The case study on the exploratory programme Shortcut to new knowledge is a three-year experimental project with around 30 small and medium-sized enterprises with no prior experiences with collaborating with researchers or academics. The initiative spurs from the Central Region of Denmark and is partially funded by Vækstforum and EU. The objective of the Region is to create appropriate conditions, opportunities, and to develop methodologies for the SMEs to collaborate with universities to draw on existing and published knowledge from the researchers in order to catalyse knowledge-based innovation; these processes may occur through interactive learning (Lundvall, 2010a).

The operator of the programme was selected by the Region of Central Denmark; the operator is the Centre for Entrepreneurships and Innovations (CEI), located at Aarhus University. In the interviews it was discussed and argued for the universities having the responsibility and obligation to disclose and make previously published knowledge available to firms and the public; this is supported by the arguments of the university having a ‘third mission’ of economic development in addition to teaching and research (Readings, 1996). The reasoning for the identified responsibility is the status of the Danish universities; there are no private universities in Denmark, solely public universities, and in certain terms acting on behalf of the state. The choice of locating the role of facilitating the knowledge-based innovation process with an operator at the university is an attempt of opening the doors at the universities for knowledge sharing.

4.1 Interacting actors

The actors involved in the university-industry interaction are the firms, researchers, intermediaries, operator and an expert panel. It may be argued that the firm, researcher, and intermediary are the primary actors, whereas the operator is secondary actor coordinating and facilitating the overall process of collaboration. The expert panel is an external auditor evaluating the applications and recommending for financial support of the innovation process. The network of facilitators of the programme – the Central Region of Denmark, the operator (CEI), and intermediaries (external actors) – are responsible for establishing the interactive learning framework for innovation processes bound on previously published results of basic research combined with a practical orientation and applicability to create value and new knowledge.

The firms interacting in the programme are SMEs of a size less than 30 employees; the actors from each SME constitutes either the whole organisation if less than ten or a selected group having dedicated time to be part of the interactive process as a project group. The other part of the collaboration is the researcher or several researchers with PhD degrees. The intermediary or broker – the external actor – has the task of project management and framing the interaction process of the active actors. The operator is responsible for assuring that the firms ‘learn’ from the interaction process with the researchers and acts as a key account manager by coordinating, planning and managing the overall activities, including providing guides for collaborations, applications templates, collaboration agreements, and other administrative activities in order for the conditions of the SME-university interactions to be optimal. The operator secures that the external actors – the intermediaries – can focus on the interactive learning process between the firm and researcher. Furthermore, an expert panel of three researchers and three business persons screen and evaluate the applications for entering the final phase of the programme as well as indicating the level of financial support; the final decision is with the operator.

4.2 Structure and approach

The structure and process of facilitating the collaboration is divided into three phases in the programme with a short description of activities in each phase.

(1) Phase 0 – the initial phase; a) recruitment of SME through the local and regional network of business service office; or b) own initiative by firms after being informed about the programme in own network; c) firms introducing their ideas for collaboration project (product, service, processes, etc.); and d) feedback on firms' ideas from the operator and support on the application process for phase 1.

(2) Phase 1 – the preparatory phase: a) identifying the needs of the firm; b) clarifying the firm's issues and challenges; c) concretising idea; d) initial matchmaking with researchers determined by professional profiles, complementaty competences and personalities; and e) firms developing a business case and apply for phase 2.

(3) Phase 2 – the completion phase: a) the completion phase, which spans over a period of 12 to 15 months, includes the collaboration between firm and researcher on a concrete project to develop new products, services, processes; b) in majority of the cases, an external intermediary manages the interaction.

The approach for the collaboration is based on the learning-by-interacting approach, which is supported by the perceptions of processes of interactive learning by Lundvall (2010). CEI, as the operator, is responsible for the initial screening from phase 0 to phase 1, whereas an expert panel evaluates the business cases for entering the university-industry collaboration from phase 1 to phase 2 as well as financial support; however, the operator makes the final decision on the application to phase 2. As stated in the midway evaluation report, the focus of the implemented methodology of the collaboration process in all the phases but especially in phase 1 and phase 2 are on a) relationship building between firms and researchers, including building trust and personal ties in the form of good chemistry, b) communication between the actors, and c) optimising the framework for utilising knowledge explorative throughout the project. The operator has a key role in the overall process of coordinating the innovation project between the

SMEs and academic researchers; the intermediary manages the particular innovation project, where the operator coordinates and monitors the process of all collaborations.

The programme Shortcut to new knowledge is similar to Perkmann and Salter's 'extended workbench', which is one of the four models of university-industry collaboration combining the two dimensions of time horizon and degree of disclosure (2012). The extended workbench is a short-term and protected model for collaboration with a high chance of implementing the academic's work and knowledge into commercialisation. This model for collaboration closely matches research areas to business's problems; Shortcut for new knowledge provides the same benefits. Building relationships with key university partners and operators for continuous collaboration is important for this type of interaction (Perkmann and Salter, 2012).

4.3 Three identified outcomes

The programme has identified three outcomes of the university-industry collaboration with various focuses areas and time perspectives. New products, concepts, services, processes are identified as tangible outcomes of the university-industry interaction, which can be commercialised in relative short term perspective. Furthermore, other value creating outcomes having a medium or long term perspective are newly acquired or developed methods for collaborations, competences and relationships building with external actors. The third identified outcome of the programme for long term gain, which is more difficult to measure, is the value added attributes of the collaborations, such as the organisational changes including behavioural, organisational culture, influences on strategic level, and effective alteration in business models.

The focus of barriers and challenges identified in the following section relates to the initial phase 0 and preparatory phase 1 of the programme, as well as the outcome of competence and relationship building for SMEs through the process of interactive learning with external actors, as perceived from the facilitator's perspective.

4.4 System- and human- based barriers

Barriers and challenges to collaboration have been identified by the facilitator of the programme; these can be divided into system-based and human-based barriers and both types of barriers contributing to the perceived gap between university and firms. Factors in the system-based barriers that support the perception distances or gap between universities and firms are the lack of platforms and frameworks for SMEs to gain access to 'known' published knowledge from researchers. The service of matchmaking is not sufficient; the sparring on ideas and needs of the firms, as well as facilitation of the collaboration process are valuable attributes for the SMEs with no prior experiences of university collaborations and need support and guidance to feel secure and in order to overcome the human-based barriers. Another system-based barrier for the university-industry interaction is the non-existing incentive structure for academics and researchers employed at the universities to collaborate with SMEs on relatively short innovation projects from an academic perspective without a guarantee of publications but the sole use of previously published knowledge applied in new and practical contexts. The programme's initial phase 0 and preparatory phase 1 are gateways for SME to enter collaboration with researchers are universities; the programme is attempting to overcome a system-based barrier by providing the platform and framework to shorten the distance between the firms and academic researchers.

The human-based barriers are bound in the perceived distance and existing differences between the actors' daily activities and behaviours. These differences contributing to the perceived distance have been identified to be rooted to prejudices on each other's world views and a missing link between the theoretical basic research at universities and the practical orientation of the private sector. The human-based factors are differences including differing organisational cultures, time horizons, educational background, communication, and various competence levels. According to Davenport et al. (1999), cultural differences between industry and university would have a positive impact on the development of competence trust. These variations in backgrounds and activity orientation of the interacting actors have been identified as positive attributes to the innovation process and outcome of the collaboration. The communication between the involved actors in the innovation process is crucial. In fact, human-based barriers have been identified to diminish when the persons from the firm and selected researcher meet and interact in phase 1 and phase 2 of the programme. The operator assists the firms in phase 1 to approach the university system with academic researcher and the external actor of innovation intermediary assures that the interacting parts get closer to each other in an exploratory process of learning in phase 2. Thus, the human interaction and relations between the two parties is essential for overcoming the human-based barriers of the perceived gap; only through interaction can the barriers be overcome and to a certain extent also compensating for the system-based barriers.

4.5 Main lessons learned

The main lessons learned on an abstract level are 1) the framework of overcoming the human-based barriers for perceived gap through human interaction and communication, 2) establishing frameworks for interactive innovation processes, and 3) learning processes.

In the initial phase 0, the operator has an important role in matching the needs and idea of the SME with the appropriate solution for the firm. The Shortcut to new knowledge programme may not be the 'right' solution, by applying known knowledge from academic researcher, as for instance collaboration on student projects or other type of assistance. The overall aim is to create value and innovation for the firms in the region; therefore, as the approaching firm is initially evaluated by the operator, then the operator should have a profound overview and knowledge of the national innovation system in order to direct the SME to the appropriate solution matching the needs of the firm.

Shortcut to new knowledge time limited programme, one out of many offers in the national innovation system. This initial contact between the SME and university, as the operator is located at the university, is the first step in narrowing the perceived gap.

In the preparatory phase 1, the operator is initially matching professional competences of the interacting actors; however, the human interaction through direct communication and face-to-face meetings is necessary in order to identify if the personalities match each other for further relationship building. Thus, the 'formula' for overcoming the human-based barriers and initial ground for collaboration in phase 2 is arguably the matching of complementary professional competences and personalities leading to interpersonal relationship and ties between SME and researcher for further collaborations and innovation processes after the completion of the explorative programme, Shortcut to new knowledge.

In phase 1 and phase 2, the interactions lead to learning where known knowledge needs to be destructed or 'forgotten' in order to acquire and process new knowledge (Johnson, 2010). The period of collaboration lasts from 12 to 15 months in phase 1 and 2; this time horizon is relatively short and may not be sufficient for all types of university-SME interaction in the programme in order for the learning processes to occur for value added outcomes of medium to long term perspectives. The programme is arguably tailored for 'low hanging fruits' which are relative short term and tangible outcomes, whereas the learning processes have a time dimension varying according to the nature of the collaboration. Therefore, a lesson learned on the time perspective of the programme is to allow for a longer time horizon than 12 to 15 months in phase 1 and phase 2 combined in order to ensure enough time for learning processes to occur.

Practical implications from the lessons learned, as identified by the facilitators of Shortcut to new knowledge, are 1) through the programme, the framework conditions have been optimised for the SME and are comparable to national programmes in for instance the United Kingdom and Germany; 2) the support of intermediaries is 'not essential' for the interaction, SMEs can also collaborate directly with researcher; 3) the university-SME interactions is also a value-added activity for 'normal' firms, without prior experiences with university collaboration or highly educated employees; and 4) independent and neutral function of the operator to coordinate and facilitate is invaluable for the collaborations. Finally, the importance of dividing the university-SME interaction into three phases gives the firm the opportunity to test if collaboration with an academic researcher is the appropriate solution or if another solution in the innovation system fits their needs and expectations, as the programme focuses on value creation through interactive learning with an academic researcher.

4.6 Conceptual framework for managing university-industry interaction

The structure of the programme which is divided into three managerial phases is illustrated in the conceptual model in Figure 1 and attempts at capturing the interacting actors, activities, and narrowing of the perceived gap by overcoming human-based barriers through human interaction and learning processes. The conceptual model is developed with inspiration from Cooper's Stage-Gage system (1990), Myers and Marquis' model for innovation phases (1969), and the managerial applicability of the programme Shortcut to new knowledge – a conceptual and managerial phase-divided innovation process. The main actors' activities for each 'gate' and 'phase' are stated, as previously presented in the earlier sections. Additionally, a sketch of the process of narrowing the perceived gap between university and firms through human interaction to overcome the human-based barriers, as well as the system-based barriers to a certain extent, is presented in the conceptual framework.

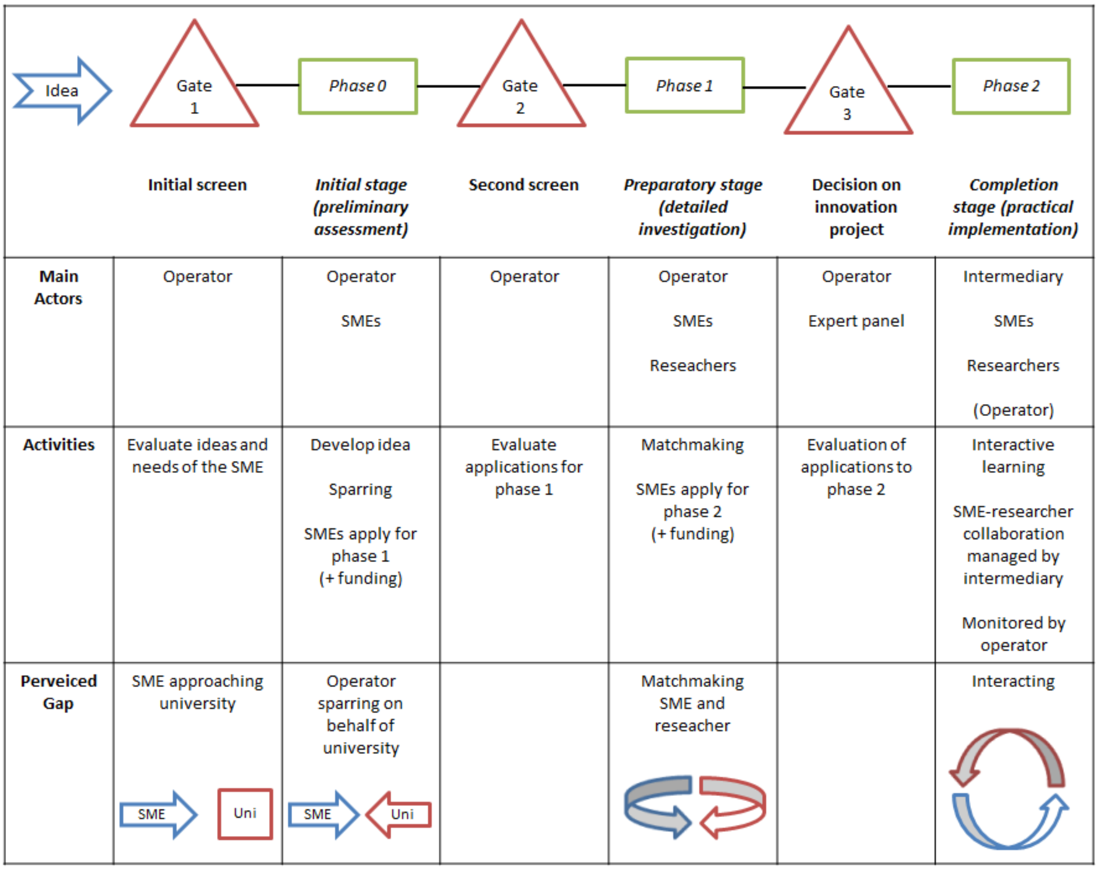

Fig. 1: Conceptual framework for managing a university-industry interaction, including a caption on human interaction narrowing the perceived gap

5 Discussions

The managerial framework for university-SME collaboration is an example of a 'solution' for mitigating the barriers of the perceived gap. The human-based barriers to collaboration are slowly broken down by the initial interaction with the operator at the university followed by the completion of the innovation project through interactive learning processes managed by the external intermediary. The programme Shortcut to new knowledge provides the platform as well as the framework for collaborations to occur; thereby an attempt at overcoming system-based barriers through human interaction. However, the incentives structures for academics to interact with firms for innovation projects are non-existing; this is a great obstacle for many researchers. The university's responsibility or obligation to narrow the distance, from basic research to practical applicability in firms, lies in the realm of the 'third mission' of economic development in addition to research and teaching (Readings, 1996). The operator, through the Central Region of Denmark's programme Shortcut to new knowledge, attempts at practicing the activities constituting the third mission of diffusing academic knowledge into the private sector through innovation projects.

Arguably, not all firms need academic knowledge, and not all academic knowledge may be applied into practice. Therefore, the distance between certain industries and particular academic areas is too great to be narrowed, and would not make sense attempting at bridging the gap. In areas where the communication channel and collaboration is creating value for the interacting parts, and innovation and economic development for the region or on national level, the framework for opening the doors for university-SME interaction should be supported by incentives structures, not only for the researchers, but also for the SME as for instance with funding opportunities. Shortcut for new knowledge gives SME the opportunity to apply for funding in phase 1 and phase 2. Demonstrating the economic benefit and value added attributes for the interacting parts is crucial for overcoming the system-based barriers. Human interaction, at the present state of the programme, attempts at mitigating the human-based barriers, which are also compensating to some extent for lapses in the innovation system for university-industry collaborations.

The structure of the programme has a group of actors 'facilitating' the university-industry interaction at various levels: the project initiator at the Central Region of Denmark for creating opportunity and platform for collaborations; the operator optimizing the framework and coordinating the overall process of interactions; and the intermediaries managing the innovation projects and frameworks for interactive learning. The group of facilitators contribute to each level of the interaction with a vision to create value and innovation from the applicability of academic knowledge in practical context in order to create new knowledge. Furthermore, in most cases the researcher enters the collaboration process after the problem has been defined and the idea has been concretized; this could be the strength but potentially a weakness or bottleneck of the programme. Matching the SME with the appropriate academic researcher in later stage of phase 1 based on the preliminary collaboration between the SME and operator in phase 0 would streamline the process of interaction. However, if the problem is difficult to define, then the knowledge of a researcher, or a group of academics, could potentially clarify the issue and assist in the phase of problem formulation; thus, the inclusion of researchers in the early stage of phase 1 should be considered.

From a communication perspective of transferring knowledge between organisations, the roles of the group of delegates from the SME and the operator located at the university could be labelled as 'gatekeepers' for external knowledge and for inter-organisational communication (Tushman, 1977). For the diffusion of knowledge and innovation internally, organisational liaisons acting as key nodes in the communication network (Tushman, 1977) should be identified in order to narrow the gap in the intra-organisational communication, in larger SMEs, which in the long run could lead to absorptive capacity building and organisational development from learning and through effective channelled diffusion of external knowledge. The operator acts as a network of gatekeepers on behalf of the university and should diffuse the external knowledge into the university, as well as bringing the knowledge from where it is known to where it is not (Petruzzelli et al., 2010; Tushman, 1977). This would affect the incentives on a personal basis for the researchers to engage in innovation projects with firms, and it would also increase the "engagement capacity" (Tartari et al., 2012; 672) of the university.

On the inter-organisational level, the intermediary has the role of mitigating the human-based barriers by managing the process, conflicts, and other issues, between the firm and academic researcher. The larger SME should identify the appropriate persons within the firm to transfer and diffuse the knowledge continuously for organisational learning and development. The programme has the focus on 'learning-by-interacting'; the SMEs have informed the operator about the changes occurring from the interactive learning process, including new communication channels, optimized internal communication, competence acquisitions, in addition to indication of changes in organisational culture, mind-sets, and working behaviour. Arguably, these observations are based on individual interpretations of the actors involved in the collaboration; however, indications of the long term outcomes, i.e. organisational learning, including changes is behaviour, communications systems, and culture are the results of continuous learning and sustaining the diffusion of knowledge from external sources into the organisation. The absorptive capacity of the organisation is the "ability to recognize the value of new information, assimilate it, and apply it to commercial ends" (Cohen and Levinthal 1990; p. 128). In the participating firms of the programme, the estimated value creations, such as the absorptive capacity, leading to potential gains in the long run cannot be measured or documented at present state. It may be argued that the effects of competence and relationship building on an individual level are transferred to the organisational learning through alterations in internal communication systems to diffuse the external knowledge into the organisation, which are maintained and practiced continuously. The evaluation of organisational learning from interacting with an external knowledge sources, i.e. universities in the programme in this case study, and the commercial implementation as well as economic benefit to the region is subject for further research.

On an abstract level, the process of reaching a point where the acknowledgement of 'the unrecognised needs' of the firm – the firm not knowing, what the firm does not know – could be affected positively by the university-industry interaction. The reasoning behind this is, the continuous process of transferring explicit knowledge from the individual to organisational level constitutes organisational leaning and development, which would lead to changes affecting the innovation processes in the firm. The process of recognition is accelerated, as the interaction with external sources expands the firm's absorptive capacity, to acknowledge the changes in the external environment and learn from acquiring and diffusing external knowledge into the organisation; at the same time in the process, the firm would recognise its own ability to innovate.

As Levinthal and March (1993) states, attention must be given to the organisational learning constrained by the three problems of 'temporal myopia,' 'spatial myopia,' and 'failure myopia.' It is important not to ignore the long run' or to lose the overview of the greater picture, as well as underestimating the risks of failure. "Learning generates successes rather than failures" and the generalisation of experiences into other areas, "as success is translated into knowledge and knowledge into successes," may exaggerate the successes of learning (Levinthal and March 1993; p. 104). It is a matter of balancing exploration and exploitation, as survival requires a mix of pursuing new knowledge and using 'known' knowledge. The process of learning in the organisation, or similar, the routinisation of converting collective experience into improved average performance influences the reliability and reduces the variability in normative behaviour of the firm (Levinthal and March 1993). This is, however, a positive aspect of organisational learning as it improves performance, but may affect the willingness to explore new external knowledge by overestimating the rate of success, based on previous acquired knowledge diffused into the firm. As suggested by Levinthal and March (1993), adjustments to incentives and organisational structure are some of the proposed solutions to the problem of sustaining exploration. In addition, universities have an explorative approach to acquire new knowledge (Lundvall, 2010a), whereas firms have a tendency to engage in exploitation of resources, such as the usage of the known. The university-industry collaborations could mitigate this issue by learning to exploit the knowledge of others as this is a major contribution to "organisational intelligence" (Levinthal and March 1993; p. 110) and development of the firms' absorptive capacity through sustained and repetitive interactions with academic researchers at universities.

The facilitation of the process may be divided into seven phases: enter, contact, discover, decide, implement, evaluate, re-contact (Minahan et al., 2009). This is a linear process; however, the re-entering of the process constructs a cycle as the innovation process and building relationships are dynamic by nature (Bessant and Tidd, 2007; Davenport et al., 1999). Combining it with the parallel process of learning, as indicated by

Kolb's learning cycle (1984) it is a continuous process, which arguably occurs along the linear 'timeline' divided into 3 phases in Shortcut to new knowledge, or at a greater level by re-entering the programme with same or different researcher. As firms want to re-experience collaborating with academics researcher for innovation, and thereby re-entering the programme after completing phase 2, back to gate 1 in the conceptual framework in Figure 1, would make it a continuous cycle of learning by interaction. As firms would re-enter the programme, the knowledge gravity, as presented in the methodology section, would arguably move down the funnel from 'medium' to 'heavy knowledge gravity.' This implication of this are estimated to have an effect on the innovation; however, this is subject for further research.

"Relations, relations, relations, relations!" is a key ingredient to university-industry interaction, as expressed by a facilitator in one of the in-depth interview and supported by the other facilitators' argumentation for the human interaction being the fundamental cornerstone. Academics share same perspective of human interaction in collaborations, as well as the importance of relationships and ties, trust, experiences, and learning processes (Bruneel et al, 2010; Christensen, 2010; Davenport et al., 1999; Johnson, 2010; Levinthal and March, 1993; Lundvall, 2010a; Perkmann and Salter, 2012; Petruzzelli et al., 2010; Tartari et al., 2012; Tushman, 1977; Zucker et al., 2002).

6 Conclusions and recommendations

The perceived gap between SMEs and universities constitute of human-based and system-based barriers, as identified through the case of Shortcut to new knowledge. One of the overall lessons learned is the importance of human interaction; it is a major contributor to narrowing the gap. Human interaction including the importance of relationships, communication, learning, and building trust through experiences is a great part of the solution to mitigate human-based barriers, and to some extent is human interaction also compensating for system-based barriers. Potential benefits of the university-industry interaction, with the right framework for learning, are knowledge creation with external partners and building 'absorptive capacity' at the firms and 'engagement capacity' at the universities. Facilitation of the collaboration processes by a neutral operator has proven to be an essential ingredient to the success of the interaction between the participating SMEs and researchers in the programme.

The methodologies embedded in the programme, and compressed into the conceptual framework in Figure 1, especially the phase-divided approach, could be applied to other organisations and institutions. Testing of the facilitated collaboration process is recommended to the public sector and larger firms. Drawing on the lessons learned from the experimental programme Shortcut to new knowledge, the implications for further applicability and introduction as a permanent opportunity in the national innovation system will have a positive and major impact on knowledge creation and innovation.

Continuous and sustained learning from interacting with academic researchers in university-industry collaborations for innovation and its effects on organisational development is subject for further research. Interesting questions include the mechanisms promoting sustained organisational learning from collaborating with a university, and the role of a neutral facilitator in this process. Studies focusing on incentivising the interacting parties for re-occurring collaborations and the implications on innovation are topics for future research.

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[i] Information obtained in in-depth interview and as it is stated in various non-academic reports on the business environment in Denmark.

[ii] The midway evaluation report – *Midtvejsevaluaring af programmet "Genvej til ny viden"(November 2012)* – is retrivable in a Danish version from the website of Central Region of Denmark: http://genvejtilnyviden.au.dk/fileadmin/genvejtilnyviden/Dokumenter/Evaluering_af_Genvej_til_ny_viden_-_19-11-2012.pdf

[iii] *Vækstforum* is a regional partnership responsible for preparing the regional business strategy and for overviewing regional growth and business development.

Entrepreneurial University: Evidence Of The Changing Role Of Universities In Modern Russia

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Abstract

Increasingly universities and other public research institutions are getting more involved in the process commercial exploitation of their knowledge based (Mansfield, 1995). In modern society universities becomes a key factor of economic development as they have to not only fulfil their teaching and research agenda but also become an active participant in the innovation process (Etzkowitz, 2003). Over the past twenty years Russia has experienced an overhaul of its social, political and economic system. The social and economic changes have had most significant impact on science and technology system. Before the 1990s, Russia was widely regarded as a science and technology powerhouse, able to hold its own in fields such as theoretical physics and nuclear technology and a world leader in space technologies. However the weakest point of the science and technology system was transferring research results from research institutions to industry. Nowadays the pressure increases for the Universities to embed themselves effectively in what Etzkowitz named a Triple Helix system of innovation, e.g. to contribute into regional and national economic development by fostering knowledge transfer between academia and industry.

This paper set to explore the effect most recent public innovation policies have had on the position of leading Russian research universities. More specifically the paper is to address the following objectives:

(1) To evaluate to what extent the role of the Universities has changed in modern Russia

(2) To analyse the path of entrepreneurial development over last 10 years

(3) To examine to what extent leading research universities adopt and implement entrepreneurial mission

In its design the paper is grounded in theoretical conceptualisation of Entrepreneurial development pathway (OECD, 2009) and EC developing framework for entrepreneurial university. The data on entrepreneurship development path were collected via survey of technology transfer and innovation development managers of 20 National Research Universities in June 2012. The primary data were coupled with desktop research of the strategy development documents of selected universities.

The preliminary results indicate that in the past 5-7 years a new type of universities has emerged, an entrepreneurial university, enabling these universities to contribute to the country's social and economic development. At the same time these universities are facing serious challenges in implementation of entrepreneurial, innovation mission due to lack of managerial competencies and inadequate development of infrastructure.

The paper has significant theoretical and practical implications. It shade light on the development of entrepreneurial university in Russia, where the process only in its infancy. The findings of the research allow to draw lessons for top university managers and policy makers interested in fostering entrepreneurial transformation of higher education in Russia.

Keywords
Entrepreneurial University, Innovation, Strategy, OECD, Russia, Third Mission.

1 Introduction

The traditional idea of the university as a semi-autonomous institution charged with transmitting knowledge from one generation to the next and creating knowledge for future generations doesn't address the modern challenges of globalisation, further political and societal pressure (Kirby, 2006; Mansfield, 1995). Increasingly universities are being required to operate more entrepreneurially, commercialising the results of their research and spinning out new, knowledge-based enterprises and play an active role in knowledge economy; in modern society universities become a key factor of economic development as they have to not only fulfil their teaching and research agenda but also become an active participant in the innovation process (Etzkowitz, 2003). Clark (1998) and Etzcowitz (1998) coined this type of universities as Entrepreneurial University.

Since late 1990s, the concept of entrepreneurial university draw attention of academic scholars and policy makers who are trying to define or/and delineate the phenomenon (Clark, 1998; Etzkowitz, 1998; Gibb, 2005; Guerrero and Urbano, 2012; Gulbransden and Slipersater, 2007; Kirby, 2006; Montesinos et al., 2008; Nelles and Vorley, 2010a; O'Shea et al., 2007; Ropke, 1998; Rothaermel et al., 2007). The existing literature covers a broad range of areas relation to the configuration and model of entrepreneurial university from re-formulating university mission and strategy and re-aligning university with external challenges and demands to embedding entrepreneurship education throughout university curricular and developing infrastructure to support graduate entrepreneurship.

The debate on entrepreneurial university is not merely academic; it presents a practical challenge to university leaders in moving their institutions to a more entrepreneurial mode.

Majority of available studies concerns with the development of entrepreneurial university in the developed economies. With a rise of emerging economies in it is becoming increasingly important to analyse the condition and the context of innovation development and the role of universities as an agent of entrepreneurship and innovation development.

Over the past twenty years Russia has experienced an overhaul of its social, political and economic system. The social and economic changes have had most significant impact on science and technology system. Before the 1990s, Russia was widely regarded as a science and technology powerhouse, able to hold its own in fields such as theoretical physics and nuclear technology and a world leader in space technologies. However the weakest point of the science and technology system was transferring research results from research institutions to industry. Nowadays the pressure increases for the Universities to embed themselves effectively in what Etzkowitz (2008) named a Triple Helix system of innovation, e.g. to contribute into regional and national economic development by fostering knowledge transfer between academia and industry.

Over last 5 – 7 years a new type of entrepreneurial, innovative universities emerged in Russia; similar to their Western counterparts, these universities incorporate Third mission, e.g. playing more active role in regional and national economic development by not only generating and transmitting new knowledge but also generating new innovative businesses. Unlike in Western countries where the process of transformation was rather evolutionary process, in Russian emergence of entrepreneurial universities was a result of a number of governmental initiatives such as projects of creating National Research Universities and Federal Universities. These particular universities are set to provide research and technological development of the regional and sectoral clusters through more effective technology transfer, as well as producing graduates for the knowledge economy.

No doubts that there are more universities in Russia that embraced entrepreneurial mission. However this study focuses on the development trajectory of National Research and Federal Universities. This decision was based on similarities in (a) strategic positioning as a centre of regional economic development; (b) starting situation - comparable place in national league tables and investments into their development strategies; and (c) time-frame of transformation into entrepreneurial universities and accompanied external environment. In this context the paper is to address the following objectives:

(1) To analyse the path of entrepreneurial development over last 5 years among selected universities.

The study is grounded in the OECD (2009) framework of entrepreneurial university. Eighteen National Research and Federal Universities were invited to fill in a questionnaire based on the OECD framework, sixteen returned the usable data.

(2) To examine to what extent selected universities adopted entrepreneurial mission in their strategic development.

In addition to questionnaire the trajectory of entrepreneurial development of eight Federal Universities was examined through evaluation of their official mission statement and strategic objectives. The analysis was looking at how effectively a new mission was communicated to different stakeholders and how a new mission was translated into a set of strategic objectives as well as the development of infrastructure to support implementation of a new mission.

2 Theoretical framework

In modern knowledge-based economies universities play a pivotal role by not only generating new knowledge (research) and transmitting knowledge to a new generation (education) but also by applying and disseminating knowledge to benefit regional and national economy (entrepreneurship) (Laukkanen 2003; Thorp and Goldstein 2010). Through 1980s -1990s governments, starting with developed economies, encouraged universities to become more entrepreneurial. That led to occurrence of an entrepreneurial university where, among other things, multiple policies and programs are put in place to ensure that the knowledge generated contributes to regional economic development (Etzkowitz 2003; Kirby 2006; O'Shea et al. 2007; Slaughter and Leslie 2001). Nowadays the concept of entrepreneurial university has been accepted in countries and institutions with different traditions (Gulbransden and Slipersater, 2007). It is universally accepted that entrepreneurial university plays hugely important role in innovation development of nations. Farsi et al (2012) also observed that the entrepreneurial university has also a role in developing the entrepreneurial culture at various levels, such as national, organisational, group, and individual. Entrepreneurial university is also critical in building entrepreneurial competencies in academic staff and graduates (Ropke, 1998).

It is difficult now to determine who was first to coin the term "Entrepreneurial University". It appears that the term was used simultaneously across Atlantic by two influential scholars Henry Etzkowitz and Burton Clark. In its essence Etzkowitz emphasised economic role a university has to play by engaging with industry and business to transfer and commercialise its technologies via licensing and spin-off. According to him "the entrepreneurial university integrates economic development into the university as an academic function along with teaching and research. It is this 'capitalisation of knowledge' that is the heart of a new mission for the university, linking universities to users of knowledge more tightly and establishing the university as an economic actor in its own right" (Etzkowitz, 1998, p.). In the same year Burton Clark published his book "Creating Entrepreneurial Universities: Organizational Pathways of Transformation (Issues in Higher Education)" which reflected the practice of five European universities. In truly Shumpeterian spirit he refers to the entrepreneurial university as one which "seeks opportunities beyond means currently available, it brings a new forms of knowledge, new types of students, new labour force connections, new problem-solving skills for government and the economy" (Clark 2001, p.21). To Clark "an entrepreneurial university, on its own, actively seeks to innovate in how it goes about its business. It seeks to work out a substantial shift in organizational character so as to arrive at a more promising posture for the future. Entrepreneurial universities seek to become "stand-up" universities that are significant actors on their own terms. Institutional entrepreneurship can be seen as both a process and outcome." (Clark 1998, pp.3–4).

Existing studies embarked on defining entrepreneurial university and explaining more specific mechanism and emergent structures of the development of entrepreneurial university (Etzkowitz 2004; Etzkowitz et al. 2000; Guerrero and Urbano 2012; Kirby 2006; Nelles and Vorley 2010a; Nelles and Vorley 2010b; G. L. Williams 2003). Despite variation in framing Entrepreneurial university many of the reviewed studies (REF) grounded in five core elements highlighted by Clark (1998) ‘a strengthened steering core, an enhanced development periphery, a discretionary funding base, a stimulated academic heartland and entrepreneurial belief”. Entrepreneurial universities transform their organisational structures and practices to better respond and adapt to the external environment (Clark 2001; Siegel et al. 2007; Wright et al. 2008). The true change occur when universities embrace entrepreneurial culture (Birley 2002; Chung and Gibbons 1997; Clark 1998; Gibson and Smilor 1991) that foster entrepreneurial behaviour at all levels (Gibb 2005). Under conditions of squeeze of public funding entrepreneurial universities seek to diversify their revenue stream. Entrepreneurial university is open associated with knowledge transfer through the formation of spin-out companies and the exploitation of intellectual property rights by faculty and students of universities (Mowery and Shane 2002; Shane 2004). Entrepreneurial culture encourages research staff to look for opportunities to engage with existing business through contract research to generate more revenue (Clark 1998; Etzkowitz 2003; Todorovic et al. 2011; Zilwa 2005). More recently embedding entrepreneurship education is seen as a function of entrepreneurial university (Collins et al. 2006; Gibb 2012; Gibb 2005). The major part of this view is to support students in the entrepreneurship career with a focus on managing independence and the capacity for expanding growth business areas or high-impact business areas.

Shift towards entrepreneurial university requires changes in strategic thinking at the top level of universities and encompassing entrepreneurial activities into the missions and internal practices within universities. According to Gibb (2012, p.3) the major issues related to incorporating entrepreneurship into the universities’ development strategy are: “its stated mission; its degree of concern for the relevance of its research output; its recognition of its role in, and level of commitment to, addressing the problems of society; the strength of its associated commitment to knowledge transfer and exchange; the related commitment to business development; and more recently its focus upon graduate employability”.

Theoretical debate in literature found its reflection in recently proposed framework by the Local Economic and Employment Development (LEED) Programme of the Organisation of Economic Development and Co-operation (OECD 2009). The framework of entrepreneurship support in universities takes evaluate the university strategy, resource based, support infrastructure to entrepreneurship and start-ups, state of entrepreneurship education and evaluation approach. Alongside with Gibb’s (2012) scoreboard for assessing entrepreneurial capacity of a university in relation to the mission and strategy OECD framework provided a foundation for the current research.

3 Methodology

3.1 Selection of the universities

Transformation of Russian HE sector started well before 2000 with limited evidence in literature (Gordienko et al. 1998; D. Williams 2008). However more systematic top-down process of modernisation of universities in Russia begins in 2008-2010 when a number of government initiatives were passed to activate the research and innovation potential of leading Russian universities. Presidential Decree of 07.10.2008 № 1448 "On the implementation of a pilot project to establish a national research universities," granted the status to two universities and later in 2009 the Resolution of the Government of the Russian Federation of 13.07.2009 № 550 twenty nine universities received the status of "national research university". The status is granted for 10 years. Simultaneously in 2008-2009 a programme of establishing Federal universities started to create anchor universities in strategic region to stimulate economic development in these regions. In 2009 to facilitate process of technology transfer and commercialisation a Federal Law #217-FZ was passed allowing Universities to participate in star-ups and spin-offs. Hence the decision was made to follow these universities to evaluate the transformation towards entrepreneurial university as it simplified to an extent the timeframe of the analysis. Moreover, all universities that obtained status federal or national research university had been recognised as leading universities in national league tables. Finally, the initiatives on creating of a new type of universities were accompanied by allocation of substantial financial resources on strategic development of these universities; between 2010 and 2012 eight federal universities received approximately $ 600m and twenty nine national research universities received approximately $1bn. Therefore the selected universities had a similar starting resource base.

3.2 Stage 1 Mission & strategic objectives

Clearly formulated entrepreneurial trategy and mission are the key elements in transofmation into enterpreneurial university (Gibb 2012). Therefore this research focused on how the entrepreneurial mission of the universities are formulated and communicated as well as how the entrepreneurial mission was translated into strategic objectives and lead to changes in organisational structures.

More specifically, the focus of the analysis was on

(1) Clarity in positioning Entrepreneurship and Innovation as central to University strategy

- Strategic commitment to local and regional development;
- Strategic commitment to business development and partnerships

(2) Brevity, clarity and uniformity of language.

(3) Strategic commitment to a broad stakeholder view of university excellence

(4) Degree to which mission direct management actions; and serve as a criterion for evaluation of management decisions.

(5) Degree to which mission stimulate and motivate

(6) Degree to which mission reflects University identity and its history.

3.3 Stage 2 Survey

Professionals responsible for implementation and delivery of entrepreneurship and innovation at eighteen National Research universities and Federal universities were asked to complete a questionnaire to evaluate the entrepreneurship development at their institution between 2008 and 2012. The usable data were collected from sixteen respondents. The questionnaire (Table 1) was organised around the following themes:

Strategy

Entrepreneurial Universities need to recognise entrepreneurship as a key part of their strategy. There has to be commitment of the top leadership team to delivering the strategy in relation to entrepreneurship. Universities may also have adapted their policies and structures to better deliver the strategy.

Financial Resources

Entrepreneurship activities in universities will be viewed as more legitimate and have a better chance of making an impact if they are sustainable in the long-term. Universities must make efforts to secure funding from other sources so as to ensure continued support for entrepreneurship activities.

Human Resources

Universities can build and foster an entrepreneurial culture by recruiting academic staff that have a strong entrepreneurship background and by providing associated career development opportunities for academic staff.

Entrepreneurship and start-up support

Entrepreneurship education and start-up support activities require dedicated structure that oversees and co-ordinates entrepreneurship activities across faculties and departments. This takes advantage of existing collaborations and avoids the duplication of work within a university and its local entrepreneurship ecosystem. Universities recognise both external and internal stakeholders and share their internal resources, knowledge and capabilities. Entrepreneurial universities build on synergies between their teaching activities and business start-up support; they facilitate access to private finance, for both student and graduate entrepreneurs, is essential to help universities build links with industry and to develop an entrepreneurial ecosystem; they offer business incubation facilities to graduate start-ups and spin-offs and assist in building links to industry.

Entrepreneurship Education

In entrepreneurial universities, everyone should have access to entrepreneurial training including staff and students. Entrepreneurship courses should be offered as an integrated suite that delivers the skills needed at each phase of entrepreneurship. It is also important to deliver entrepreneurship education with “real” entrepreneurs as much as possible and use a variety of teaching methods. Alumni can provide links from the institution to industry and can provide an important source of expertise and experience that can be used in entrepreneurship education and support services.

Evaluation

To ensure that entrepreneurship activities are reaching their full potential, they should be regularly monitored and evaluated. Monitoring and evaluation should measure changes in participants’ motivation and the level of competence in the skills gained through the entrepreneurship education activities.

Factors	Criteria
Strategy	A broad understanding of entrepreneurship is a strategic objective of the university, and there is top-down support for it.
	Objectives of entrepreneurship education and start-up support include generating entrepreneurial attitudes, behaviour and skills, as well as enhancing growth entrepreneurship (both high-tech and low-tech).
	There are clear incentives and rewards for entrepreneurship educators, professors and researchers, who actively support graduate entrepreneurship (mentoring, sharing of research results, etc.).
Financial Resources	A minimum long-term financing of staff costs and overheads for graduate entrepreneurship is agreed as part of the university's budget.
	Self-sufficiency of university internal entrepreneurship support is a goal.
Human Resources	Recruitment and career development of academic staff take into account entrepreneurial attitudes, behaviour and experience as well as entrepreneurship support activities.
	Human resource development for entrepreneurship educators and staff involved in entrepreneurship start-up support is in place.
Entrepreneurship and start-up support	An entrepreneurship dedicated structure within the university (chair, department, support centre) is in place, which closely collaborates, co-ordinates and integrates faculty-internal entrepreneurship support and ensures viable cross-faculty collaboration.
	Facilities for business incubation either exist on the campus or assistance is offered to gain access to external facilities.
	There is close co-operation and referral between university-internal and external business start-up and entrepreneurship support organisations; roles are clearly defined.
	Entrepreneurship education activities and start-up support are closely integrated.
	Access to private financing is facilitated through networking and dedicated events.
	Mentoring by professors and entrepreneurs is offered.
	Entrepreneurship support in universities is closely integrated into external business support partnerships and networks, and maintains close relationships with firms and Alumni.
Entrepreneurship Education	Entrepreneurship education is progressively integrated into curricula and the use of entrepreneurial pedagogies is advocated across faculties.
	The entrepreneurship education offer is widely communicated, and measures are undertaken to increase the rate and capacity of take-up.
	A suite of courses exists, which uses creative teaching methods and is tailored to the needs of undergraduate, graduate and post-graduate students.
	The suite of courses has a differentiated offer that covers the pre-start-up phase, the start-up phase and the growth phase.
	Out-reach to Alumni, business support organisations and a firm is a key component of entrepreneurship education.
	Results of entrepreneurship research are integrated into entrepreneurship education messages.
Evaluation	Regular stock-taking and performance checking of entrepreneurship activities is undertaken.
	Evaluation of entrepreneurship activities is formalised and includes immediate (post-course), mid-term (graduation), and long-term (Alumni and post-start-up) monitoring of the impact.

Table 1 Self-Assessment of Entrepreneurship Development Pathway

4 Results and discussion

4.1 Development of entrepreneurship mission and strategy

In Russia systematic process of transformation of Universities into entrepreneurial institution is in its infancy. Figure 1 illustrates, that selected universities started from almost a zero point. In fact the respondents indicated that in 2008 9 out of 16 selected universities did not incorporate entrepreneurship mission and strategy, did not have any support services and infrastructure to entrepreneurship and start-ups; 13 out 16 universities did not have long-term financing for entrepreneurship and did not have entrepreneurial orientation in recruitment and staff development; 11 out of 16 universities did not have dedicated personal to coordinate entrepreneurship activities, nor incubation/start-up support facilities, nor access to external private investment and business networks. Only in 5 universities there were some elements of entrepreneurship education and only 4 universities report presence of evaluation system. By 2012 all selected universities have integrated entrepreneurship into their mission and strategy, committed to long-term financing entrepreneurship activities, embedding entrepreneurship education into curriculum and developing evaluation system. Only 2 universities reported absence of entrepreneurship in human resource strategy.

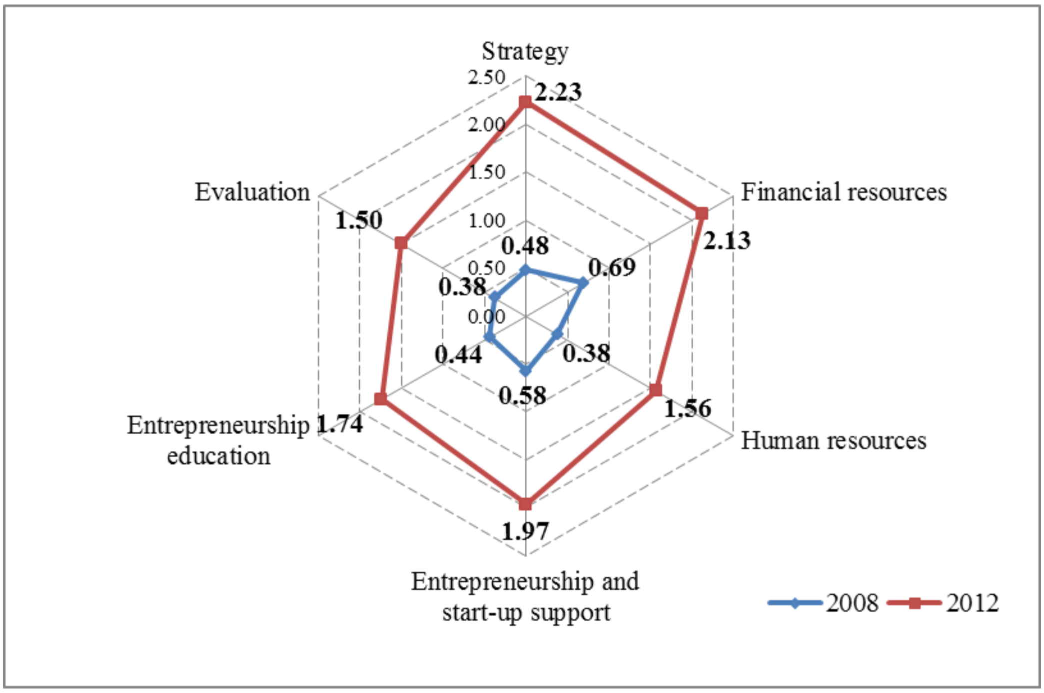

Figure 1 Trajectory of Entrepreneurship Development

Despite the progress made (Figure 1) the present state of the selected universities is far from comprehensive development of entrepreneurial ecosystem. Only incorporating entrepreneurship into university mission and strategy and financial resources scored over 2 points (out of 5). All other indicators scored below 2 points. As it was mentioned earlier, all selected universities are in receipt of a substantial state funding (compare to other HEI in Russia). Hence provision of financial resources for entrepreneurship activities can't be totally attributed to the universities themselves.

After the development of strategy and financial resources, development of entrepreneurship and start-up support and embedding entrepreneurship education are areas that has been considerably advanced since 2008. All selected universities have some elements of business support infrastructure (Technology Transfer Office, Business Incubator, Technopark, and Business Portal). However level of development and sophistication of services provided is limited (Figure 2).

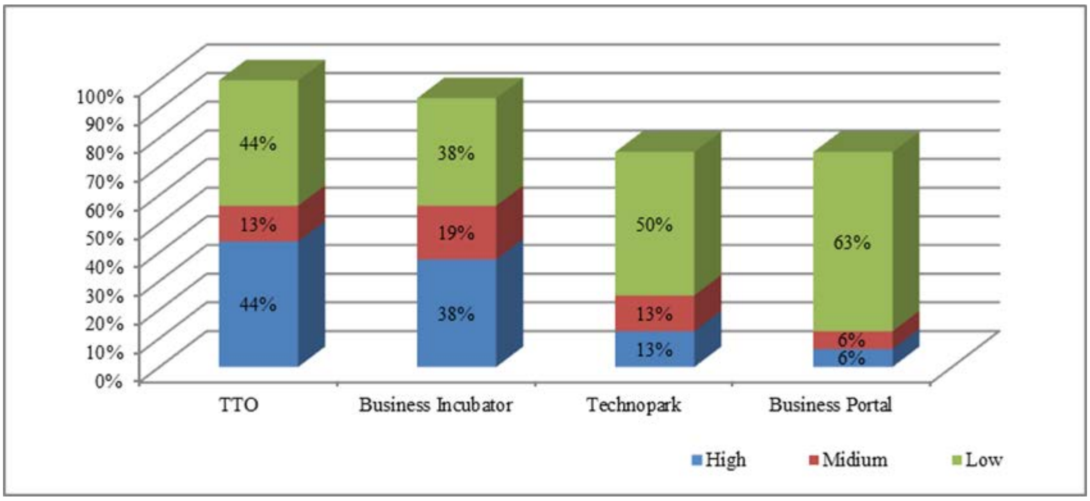

Figure 2 Level of the development of the entrepreneurship support infrastructure

The research highlighted a considerable interest in entrepreneurship related training among academic staff and students. 66% of respondents indicated that there is an interest in cross-disciplinary entrepreneurship related courses and over 70% of respondents reported interest in entrepreneurship training for academic staff and research students.

4.2 Evaluation of trajectory of entrepreneurship development

The analysis of entrepreneurship development at the selected universities indicated that most of the attention over last 5 years federal and national research universities have paid to articulating mission and formulating entrepreneurship strategy. Figure 3 presents results of the analysis of university strategies based on criteria outlined in methodology.

Evaluation of strategic development documents of the selected universities, majority positions themselves as entrepreneurial universities. The most interesting observation is that in an attempt of re-vamping university strategy many universities (62%) failed to reflect university traditions, history and identity. Some of Federal universities were created by amalgamation of several universities in a region which has presented a challenge of integrating different values and cultures in one institution. Although strategic development of selected universities made a good attempt to position these universities in a centre of regional economic and innovative development, they are relatively vague in outlining key stakeholders, their needs and interests. Most of the activities are focused on research and educational mission of an institution: “Strategic goal is to be recognised as national and international scientific, educational and cultural centre of the …Region of Russia with developed innovative, educational, scientific, social and cultural infrastructure, providing high-quality education and training of highly qualified personnel capable of ensure the development of high technology industries and modernization of economy and social sphere of the region”. However some universities have more ambition missions and objectives: “The mission of … University is to increase competitiveness, re-industrialization, formation of human, scientific and technological potential, sustainable modernization of traditional economy branches and development of post0industrial economy of the .. Federal District. The strategic goal is to form research, educational and innovation cluster with the University in its core.”

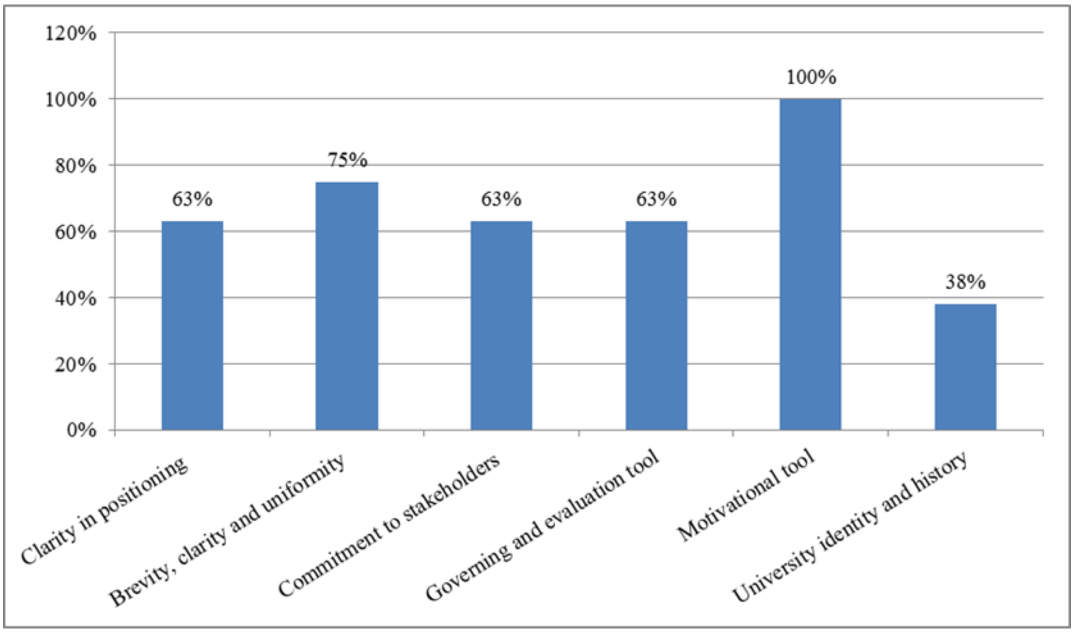

Figure 3 Analysis of University Missions

Further decomposition of university mission and strategy was focused on assessing how entrepreneurship activities were translated into universities policy and practice. Figure 4 illustrates how the entrepreneurial orientation of university strategies has changed over time. The survey data confer with analysis of university development strategy indicating that there is a broad understanding of entrepreneurship is a strategic objective of the university, and there is top-down support for it. According to the survey data there is a long way until entrepreneurship is fully recognised a strategic objective.

An area where universities can express their entrepreneurial value is a reward system, which reflects the importance the organisation places on commercialisation of research, and more importantly, the role of the researcher in this process (Di Gregorio and Shane, 2003; Link and Siegel, 2005; Quince, 2002; J. Smith, 2003). The survey data highlight the lack of incentives for entrepreneurial staff. Only in two universities there were incentives and rewards for TTO staff; seven universities reported presence of rewards for academic staff which involved bonuses and peer recognition.

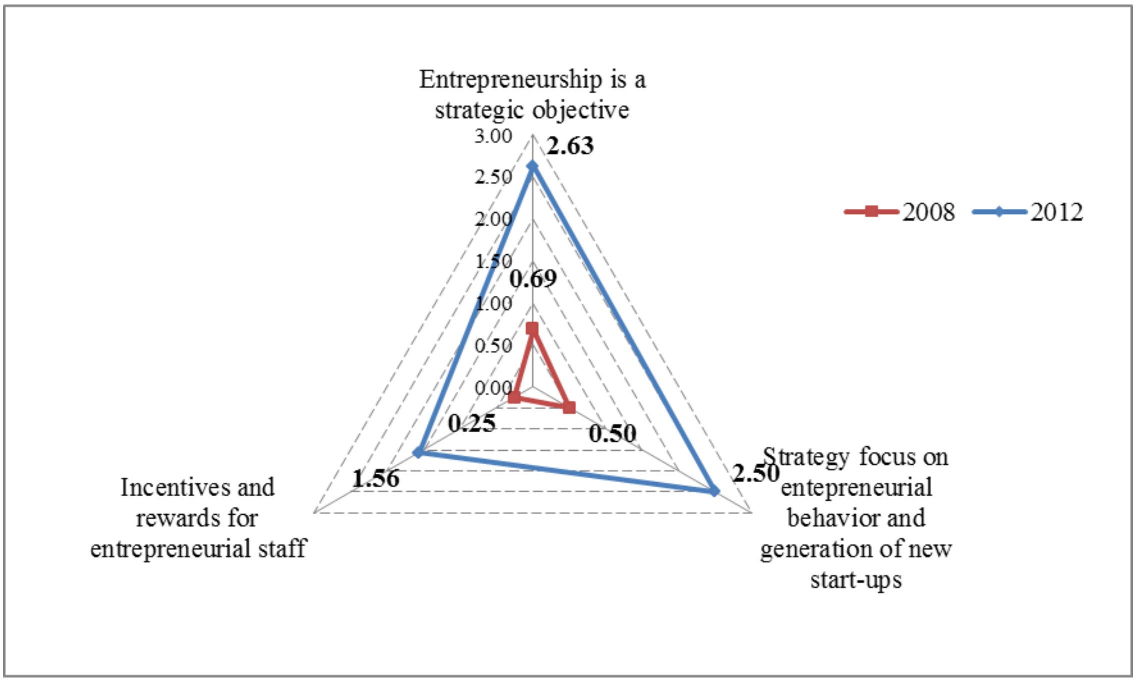

Figure 4 Development of Entrepreneurship Strategy and Mission

In recent years a key initiative of the Government of the Russian Federation in developing entrepreneurship and innovation ecosystem in HEIs was a Federal Law FZ-217 allowing public research organisation such as universities to participate in formation of start-ups. Commercialisation of research output and generation of new businesses was named a national strategic priority. The Governmental policy found it's reflection in setting priorities in university's development strategies (Table 2). The survey data also demonstrate that university strategic objective in relation to generating entrepreneurial attitudes, behaviour and skills, as well as enhancing growth entrepreneurship (both high-tech and low-tech) have considerably increased its importance.

Activities	Percentage
Generation of start-ups	90.0%
Building awareness on importance of entrepreneurship among academic staff.	80.0%
Building awareness on importance of entrepreneurship among undergraduate, graduate and post-graduate students	80.0%
Industry contract research	70.0%
Licensing	70.0%
Patenting	65.0%
Support to interdisciplinary research	55.0%

Table 1 University priorities in entrepreneurship activities

5 Conclusions and recommendations

At present in Russia due to large-scale governmental programme of development of Federal and National Research universities a new type of HEIs is rapidly emerging – Entrepreneurial University which expected to be in a centre of innovation-based social and economic development. New role of universities presents a challenge to leadership and management of university and requires putting entrepreneurship and innovation in the heart of the development strategy. However the transformation of leading Russian universities into entrepreneurial organisations is in its infancy. Although there is a growing understanding of entrepreneurship as a key strategic objective, the understanding is somewhat narrow with focus on generation of new start-ups and neglecting a broader understanding by developing entrepreneurial behaviour and attitude among staff and students. Financially selected universities largely relying on public funding; while diversification of financial base is stated as an objectives, universities admit that main barrier in this respect is the lack of industry demand for innovative solution..

Even though the most advance area in building an entrepreneurial university is development of support infrastructure, the level and quality of services is limited; they tend to be tailored mainly to the start-up stage and missing further stages in venture development. Moreover, development strategies put more emphasis on “knowledge creation” elements such as new basic research centres with less attention given to “knowledge exploitation” elements such as applied research and technology transfer and incubation services.

There is recognition of importance of a broader range of stakeholders but universities do not have strategies for effective engagement of stakeholder groups in entrepreneurship process. Despite significant interest in entrepreneurship education is only recently started to be developed but it is still mainly outside of major curricular. Although the recognition of a wide range of stakeholders is growing, their needs and interests are poorly reflected in university development strategy documents. The outreach to alumni and external business support organisations are weak.

Despite significant lag in entrepreneurship development Russian universities have an opportunity to leap frog by learning from substantial management practices of universities from developed countries in creating entrepreneurial university, e.g. developing system of motivation and support for entrepreneurial staff, cultivating culture of innovation, action and effectiveness, providing an adequate resource base for high-growth ventures and educating new generation of graduates able to facilitate and manage innovation processes.

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Role Of Contractor In Enhancing Small Technology Transfer Offices Outreach: Leveraging Stakeholder Support Offices Outreach

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Abstract

It is a well-known fact that many universities with small technology transfer offices (TTOs) are constrained by budgets and staff turnover. This limits the resources available to the TTOs to market innovations and bring into the university the much needed sponsored research dollars and licensing income. Lehigh University's TTO (which is a young and small office) and Foresight Science & Technology (Foresight or contractor) both recognized this issue and have been working towards developing a unique hybrid out-sourcing model to overcome this limitation. Foresight has been a market leader in technology commercialization in the USA for over 30 years. Foresight has a wide connection into the industrial landscape and has successfully assisted a number of companies and government agencies' in commercializing their innovations. A founding principle of the Foresight methodology is to leverage the "voice of the customer" into the evaluations of propositions; this ensures that roadblocks to commercialization are identified early and creates the initial industrial engagement separate from any sales activity. The ability of Foresight, or indeed any equivalent third party contractor or technology transfer (TT) professional, to leverage its networks and obtain the "voice of the customer", assists in obtaining that all important industry validation. By using a contractor with a wide reach, the propositions are being introduced to industry by a trusted party and this helps build the long-term relationships between industry and academia. Consequently, leveraging the expertise of the contractor can lead to greater awareness of a university's research strengths, thus resulting in reducing the time to market for inventions/propositions. Another feature of the hybrid out-soured model is to control the costs for the TTO, typically the external contractor can be less costly than a permanent employee with specific market expertise. Lehigh and Foresight have developed a unique relationship, working together on assessing intellectual property and defining strategies according to market pull.

The objective of this paper is to showcase the hybrid out-sourcing model and also exhibit how leveraging the industry connections, business expertise and experience of an established contractor can reduce internal costs for successfully moving intellectual property (IP) from the laboratory to the marketplace. In summary, as a result of Lehigh contracting with Foresight, there has been a stronger relationship between the TTO and faculty, faster identification of licensees, and more long-term relationships between the academia and industry.

Keywords

Technology Transfer, University-Industry Interaction, Contractor, Limited Resources, Commercialization, Stakeholder.

1 Introduction

Effective technology transfer requires a knowledgeable team and a structured process to move intellectual property to the marketplace. To deliver all of what is required can be quite difficult for institutions with small and/or emerging TTOs with very limited resources. Often times the conflicting priorities ever present in a TTO make it difficult to follow-up with licensing leads while concurrently providing the faculty with the support they need in terms of identifying early-stage technologies with commercialization potential, providing "gap" funding to bring technology forward and connecting with potential industry partners for out-licensing, etc. When the necessary resources for commercialization are restricted, the ability to bring in licensing revenue and research dollars is greatly obstructed, limiting the overall potential for TTO success.

This paper focuses on the challenges of small TTOs where staffs, budgets and resources are restricted (in various combinations) and outlines a model to properly conduct the focused outreach activities using a contractor (Foresight Science & Technology Inc.) as the outreach arm for the TTO. This approach leverages the business and marketing skills of a commercialization firm whose core expertise is assessing market pull to effectively move technologies into the supply chain.

The paper is structured in four sections; Section I is the Introduction; Section II is the Background and Need for developing a stakeholder partnership; Section III is the discussion of the proposed Model and Findings; Section IV is the Inventor Perspective working within this model; and Section V is the Conclusion providing the advantages of the proposed model.

2 Background & need

Technology Transfer (TT) in the United States dates back to 1945 as identified by Vannevar Bush on behalf of President Franklin D. Roosevelt. (Lawrence Livermore National Laboratory, 2012). The idea was to create a strong community for basic research to improve the economy. This led to government funding agencies developing policies for dealing with intellectual property followed by more guidelines and best practices for out-licensing of the IP. Over the past 70 years technology transfer has become a focal point for many universities, not only in the United States but internationally as well. It is also a major factor in government policy (Rockefeller Foundation IP Handbook, 2012). In the United States the passage of the Bayh-Dole Act together with Stevenson-Wydler Technology Innovation Act in 1980 is credited, in some quarters, for the technology-based economic growth of the latter part of the last century. Universities and other publicly funded institutions define commercializing IP as a measurement for success. There is a counter perspective that patents are a right to exert protection for "*market share of a risk taking investor*" to recover that risk investment and therefore, using patents as a metric of innovation is inappropriate (Jamison, 2011). However, over the last decade the broader aspects of Knowledge Transfer/Exchange in socio-economic development have become more recognized. This is noted by the AUTM's "Proposal for the Institutional Economic Engagement Index" (AUTM, 2009) and the inclusion of the Research Impact measure within the UK higher education funding bodies' Research Excellence Framework (REF) strategy that built upon the Warry Report (2006). Under this REF framework of assessment and reporting for the Research Council of UK, the academic as well as the diverse economic and societal impacts of research activities have to be captured (RCUK, 2013).

In the current economic climate it is noteworthy that many countries have not massively decreased their investments in technology transfer (and knowledge transfer), though at an institutional level this may be the case. The trend for universities and government agencies to become commercially focused has meant that researchers and funders expect technology transfer offices to be successful, regardless of their size and the resources at their disposal. However, there are still many issues (aside from the lack of access to alumni and student networks) that need to be addressed for effective utilization of the TTO as a way to generate income into the university/institution. This is especially critical for the smaller TTOs, the majority of which have existed for only a short period of time, usually a decade or less. The noted drawback that TTOs are often not successful in the first decade of establishment (Young, 2000) further highlights the problems of the TTO if they are isolated from other activities associated with the wider knowledge transfer agenda. In fact, most new TTOs take at least one decade to break even and twice that period to begin making an impact on the economy (Nelsen, 2007). This gestation period for the TTO to potentially transition from a "cost center" to a "profit center" (with no guarantee that the transition will occur within the tenure of the university stakeholders) hinders many universities' administration to invest resources into commercialization activities. In research-intensive universities, with sizeable grant overheads, senior administrators can often justify investments in their TTOs. Unfortunately, for smaller institutions the TTO is less able to guarantee success.

It is estimated that 10% or less of patents will lead to royalty revenue back to the university (Nelsen, 2007). The University of California's "Report of the Working Group on Technology Transfer" noted "*to maximize revenue potential, UC must invest resources…for all elements of technology commercialization* (University of California, 2011)". The report from early 2013 also provides interesting reading regarding metrics: it was noted that less than 0.2% of disclosures accounts for 80% of revenues; from a thousand disclosures only 40 lead to products that generate royalty income; and only one will lead to royalty income exceeding US $1m over the life of its patent(s). Yet, the UC system's total income available (net of legal settlements) from technology transfer for distribution to inventors and the University was US $164.6 million in 2011. Thus, the critical observation in the case of UC system is, when there is an established level of income from TT activities that results from a large research base and a decade of activity in a dynamic research ecosystem of inventors and entrepreneurs, the ability to reinvest to generate a sustainable financial model for a TTO can be achieved. However for small TTO offices or those offices newly created, where funding and resources are typically scarce, picking winners from the multitude of disclosures is even more critical than it is for established offices in order to generate a sustainable model for the TTO.

It is unsurprising that being able to identify those patents/disclosures most likely to succeed and effectively market them to secure a commercialization partner is a key factor for success in technology transfer activities. However, it is also recognized that some TTOs may lack the appropriate resources (staffing, deal intelligence, etc.) to do so (Tornatzky, 2000). So the question arises, how do we address all of these challenges to accomplish the objective of TTOs to improve the economy? One solution is to exploit a hybrid out-sourced model, which we will discuss in detail in Section III of this paper.

For those TTOs that do not exist within a dynamic innovation ecosystem, where local entrepreneurs and high technology companies have close interaction with academic researchers and drive the commercialization process, it is often the TT professional who will drive the commercialization activity for the researcher. However, the limitation of this market push approach is well documented. Thus, when a new disclosure is made, one of the primary objectives of the TTO will be to understand the landscape of the technology and its applications, the industry within those fields and the supply chain(s) involved. With the objective of the TTO to create value from innovation, Lehigh aimed to address the issues highlighted earlier by creating a stakeholder relationship with a contractor.

Lehigh explored various options and communicated their needs with several different types of contractors available in the market. Unfortunately, none of the market specialist contractors could deliver the partnership model that Lehigh needed: one that was both cost-effective (minimal upfront expense) and process efficient (provide successful market connections). Foresight was willing to experiment to develop the collaboration since it recognizes that even in today's virtual networking and social-media age, technology transfer remains a "contact sport", since it is the trust-based relationship that delivers the deal. Identifying the appropriate contractor was an essential step in transitioning the contractor to a stakeholder. Many organizations and universities, including the Association of University Technology Managers, note the role that consultants (or contractors) can play in bringing technology from lab to market (Association of University Technology Manager, 2012). TTOs thus may leverage commercialization experts to conduct marketing and licensing activities cost-effectively and efficiently.

3 Model & findings

Figure 1 below outlines in graphical form the points in the technology transfer supply chain where Foresight, or a contractor, fits in and can be involved based on this model.

Throughout this section of the paper we will address each stage and the activities the contractor performs as part of the outreach efforts on behalf of the TTO.

Figure 1: Technology Transfer Process with Stakeholder Participation

Lehigh University (Lehigh) has partnered with Foresight Science & Technology (Foresight) as a contractor to play a stakeholder role in the technology transfer supply chain to create an effective, long-term relationship. It is first important to recognize the slightly different objectives between the contractor and the TTO. The TTO's mission is to create social AND economic impact (although internal financial metrics remain an important metric for internal stakeholders) while the contractor's intention lies within creating economic benefit to them. As such, when an assessment is being carried out for new disclosures, contractors may recognize the societal benefits but their primary objective is identifying the impediments to realizing the economic benefits of the technology. The propositions that have potential for economic benefit are those propositions Foresight as the contractor can handle.

The questions then arises as to why would a TTO "offload" those propositions that have been identified by the contractor as having market pull rather than manage these in-house? This is really a question about resource allocation. The TTO has to manage at least four aspects of equal importance; in-reach, due diligence, outreach, and administrator support. In smaller TTOs, the key staff is likely to be already stretched. So, as new disclosures come through and commercially viable technologies are identified, there are more propositions to manage, yet the resources remain scarce. As time goes on, with more disclosures and more opportunities to handle, the TTO's key staff may not be able to allocate more of the TTO's resources to outreach efforts without significantly affecting in-reach, due diligence or stakeholder management activities. By outsourcing the outreach you are not sacrificing the other aspects; you are creating stability for maintaining the status quo. Building from this burden of essentially fixed, limited resources Foresight also recognized that in many TTOs staff turnover also creates an impediment to successful outreach activities. The TTO now has a robust framework and from this stability the trust based relationships with both the faculty and industry can emerge since they are typically only interacting with validated leads. It is this understanding that helped shaped the Foresight-Lehigh model and is the reasoning for Foresight's engagement during the Go/NoGo Assessment stage as indicated in Figure 1.

Foresight has a long established reputation within the Small Business Innovation Research (SBIR) community for delivering commercially grounded assessments and identifying corporate partners strategically positioned in respective supply chain. We recognized the opportunity for this skill set to be applied more creatively within the technology transfer supply chain of universities, most notably as a provider of outsourcer outreach services in support of the TTOs metrics. This recognition addresses the reasoning for Foresight's engagement in the Marketing Strategy and Implementation stage in Figure 1. The opportunity to work with Lehigh to develop the relationship and the model we outline in this paper has allowed Foresight to recognize the stresses for the TTO to generate economic success and the potential rewards for assisting in that role. Foresight, with its deep reach into the industrial landscape of the US, and increasingly in other territories, has the ability to rapidly identify potential leads, qualify those leads for the client (Lehigh in this case) and facilitate the management of the transaction in an effective, efficient manner. This is not to say that TTOs are unable or unwilling to do this activity, rather it is a pragmatic recognition that often the TTOs need outreach support due to the stresses placed upon them and scare resources. As such, Foresight's involvement in the Deal Making stage of the technology transfer supply chain as indicated in Figure 1 is justified by this acknowledgement.

Now that we have established the reasoning for creating the relationship between Foresight and Lehigh and the stages in which Foresight adds the most value, we look at the actual participation of each party. The initial step in the commercialization process is to identify commercially viable propositions from disclosures, providing preliminary IP protection strategies, and identifying and engaging with prospective licensees. Part of the reason TTOs are a cost center is that allocating resources to the number of disclosures creates a cost hurdle that has to be breached by the very few propositions that generate income – note the University of California numbers that only 40 from 1000 disclosures are royalty generating. Therefore, increasing the efficiency and effectiveness of disclosure weeding and improving the transition from disclosure-to-deal improves the overall cost-effectiveness of the TTO. Foresight provides to Lehigh assessment advice on which technologies merit, purely from a marketability standpoint, resource allocation. Foresight utilizes their market knowledge and ability to ascertain the voice of the customer as an early stage weeding tool to identify showstoppers to commercialization before significant resources are spent on a technology. This task saves the TTO valuable time in determining what technologies to move forward with and creates the first stage-gate in the commercialization process. This highlights one of the divisions of labor between the TTO (that of in-reach, stakeholder management and taking responsibility to protect the institution's interest etc.) and that of the contractor (that of aligning market needs with functional characteristics of technology disclosures). As we mentioned earlier, the TTOs resources, from a staffing perspective, are very limited and leveraging the stakeholder expertise to efficiently and quickly identify key technologies reduces the investment required to conduct well-informed assessments.

We now start to look at the second stage of this model's evolution in the commercialization process. It was found that additional support from Foresight would be valuable to Lehigh to ensure the chosen technologies had a viable commercialization strategy and, importantly, that strategy was followed-through and monitored. This would allow the university to supply the innovative technology and use the contractor's understanding of industry to market the technology and to facilitate deal making if traction occurs with a potential licensee.

The skills found within the contractor's core competencies needs to be complimentary with the TTO's. Industry, for many years, has recognized the need to exploit external skill-sets to supplement internal expertise and out-sourcing is an established tactical approach to increase efficiency and profitability across all areas of commerce. Although TTOs exist within institutions that are typically not for profit, the increasingly commercial management of institutions and their growing focus for more industry-academia partnerships requires the TTOs to be more fiscally efficient. More often than not, those metrics can be described as being sustainable and adding value to the overall organization. In this context, out-sourcing the skills to develop industry connections for licensing to a stakeholder (not just a contractor) was a necessary and valuable mechanism for Lehigh to meet its metrics.

The key expertise of the contractor also involves marketing and access to other mediums including social media, conference attendance and face-to-face meetings with established contacts. It is noteworthy that staff turnover at TTOs mean that "corporate knowledge," including up to date contacts and lead status management, may be at risk and it is acknowledged that technology transfer is a "contact sport". However, investing in and maintaining customer relationship management systems across diverse industries, although desirable, may simply not be viable for many small TTOs.

In addition, the ability to grasp a target's due diligence process as they evaluate their interest is necessary. Working with the target through the due diligence process is time consuming for the TTO. Furthermore, in order to reach these targets, access to the right networks is required, which again may not be available to the TTO. Out-sourcing the outreach and marketing efforts to a trusted contractor offers greater access to the right targets, the know-how to properly present the technology, and the ability to better engage with those targets to develop long-term relationships. Lehigh is thus increasing the potential success of moving technology from lab to market by leveraging their internal skills with those of external partners.

At the same time, the movement through a target's due diligence process requires input from the innovator themselves. The TTO can focus its efforts on in-reach to the faculty/inventor for delivering the necessary information to further engage the interested target as the stakeholder guides the TTO through the perspective of the target. The TTO also needs make sure there is support from the university administration for the framing of the relationship with the target to ensure the deal that is structured falls in line with the university's mission. We are once more highlighting the need to divide the labor of the commercialization process for efficient and effective results.

We have discussed the mutual understanding between Lehigh and Foresight that outsourcing the outreach process is most effective in reducing overhead costs to the TTO and employing its core competencies to the fullest. Now we will discuss the pricing aspect of this model, which is vital to its realization. One of the key stress factors from a contractor's perspective is managing the financial investment and minimizing the "unlimited liabilities" associated with an outreach campaign. Consequently the outreach efforts conducted by Foresight on behalf of Lehigh are remunerated based upon funds received by the TTO from the target. There is a minor upfront component that pays for the initial proposition assessment, but the incentive to Foresight is to align itself with the TTOs objective of getting the innovation to market as fast as possible. This model addresses the budgetary limitations of small TTOs highlighted in the background section of this paper.

Foresight is a for-profit company and it is understood not all university technologies will reach a successful outcome that brings in dollars to the TTO. To this end Foresight recognized a need to set boundaries for ending outreach efforts or re-addressing them at a later point in time and has developed a 6 month cycle approach. There is a particular emphasis on the availability and completion of up-front "technology transfer packets" (i.e. non-confidential/ confidential supporting documentation) to ensure that any movement generated in the initial outreach activity is maintained through to winning over the key opinions leader/internal champion within a target company. If after the first 6 month cycle, traction is generated, then there is justification for follow-up and continuing efforts. Important to note here that the general rule of thumb from a contractor perspective is being robust in accepting only those projects which merit commercialization. That is, there should be no fundamental marketing roadblocks and propositions ought to have a supporting faculty member. If at the end of a 6-month cycle there is no traction, Foresight ascertains if this is due to the market environment or the technology and recommends if re-engagement at a future time is necessary once the market environment is friendlier or the technology is more mature / de-risked. This reiterates the idea of controlling costs and resources and for creating wider relationships, such as those with government agencies and with those parties who have an interest in maturing the technology independent of a commercial interest. To this point, the importance of sponsored research to a TTO should not be underestimated since development of sponsored research programs could lead to licensing. Typically most contractors are not interested in sponsored research and need to be incentivized if sponsored research is an option identified during the outreach efforts. This will ensure they have an alignment to the TTO and not be financially penalized as a consequence of it. The Foresight model is geared around being rewarded on the upside and not via fees. This creates a partnership of similar interested and shared goals with the TTO and reinforces that Foresight is not purely there to “work for the fees.”

4 Inventor perspective

From an academic researcher/inventor perspective, the Lehigh-Foresight relationship has been a very satisfying and rewarding experience. For a junior faculty member who has an interest in technology development and commercialization, it is often difficult to identify the appropriate resources available at a university to assist with TT. In particular, this includes (1) providing guidance as to whether a particular early-stage technology is worth pursuing, (2) assisting in identifying “gap” funding based on initial feedback from industry to address issues necessary to bring a technology from early-stage to pre-commercialization stage, and (3) connecting technologies to interested industrial partners to provide a framework for sponsored research or out-licensing agreements. This is especially important given that many junior faculty are not exposed to SBIR or other technology commercialization-oriented grantsmanship or funding opportunities as part of their academic training. Yet, many have an interest in exploring technology commercialization further as a mechanism to diversify the types of research being pursued as part of their academic careers. This is particularly of interest given the current changing funding landscape in the US for academic research grants, in which diminished funding in basic science has occurred in parallel with increased or no change in technology-commercialization focused research grants. The Lehigh-Foresight partnership outlined in this paper and the process illustrated in Figure 1 has provided a unique, valuable resource for faculty. One such junior faculty member’s experience (Dr. Bryan Berger, co-author) is highlighted below with his desire to pursue technology commercialization activities.

First, the integration of Lehigh TTO with Foresight has been valuable at an early stage in organizing specific research tools and technologies developed in Bryan's lab around a common "theme" aimed at commercialization. In particular, there are often several, related technologies being developed in a lab, but it is not clear whether these technologies have commercialization potential on their own, in combination under a common application or as parts of other technologies being developed. In this sense, Lehigh TTO acts as a "pre-filter" to assess the impact of this work and whether it has market potential. If so, then working jointly with Lehigh and Foresight, the latter of which has a broad base of industrial partners and prior experience, to identify a specific market and identify weaknesses in the technology becomes helpful in providing critical feedback early in the development processes as to whether a technology was worth investing time in terms of laboratory research efforts. In one specific instance for a nanoparticle-based manufacturing technology, which Lehigh since filed a patent application for, Foresight and Lehigh were able to provide the inventors with specific market areas where their technology would be most effective, many of which were not previously considered in their research. This information was used in the subsequent research they performed in lab to develop a much broader "theme" aimed at low-cost, contract nanoparticle manufacturing rather than the specific "theme" of engineering nanoparticles for a particular end-user application in energy generation they thought would be most applicable. In this way, they were able to make connections to multiple interested industrial partners in diverse areas including energy, biomedical imaging and lighting/display technology.

Second, once the technology had successfully passed through the Lehigh-Foresight "pre-filter" to create a suitable "theme" and industry focus, they were able to connect directly with potential industry partners to gain feedback on the advantages/disadvantages of their technology. For a relative newcomer to this field of research and certainly to technology commercialization, this was a valuable opportunity for Bryan to gain direct access to industry experts in the areas he was targeting with the technology and ask questions regarding what the key performance criteria were that the companies were most interested in terms of forming a relationship. Interestingly in the case of the nanoparticle manufacturing technology, they found that cost, which was believed to be most important based on extensive analysis available in the scientific literature, in fact often was not the more relevant factor to potential industrial end-users of their product. Rather, while the end-users were more interested in striking a balance between cost and performance, most were willing to tolerate higher costs than that reported in the scientific literature in order to attain higher performance features. This allowed Bryan and his team to refocus their efforts on research aimed at improving material properties and not spending additional effort towards costs minimization, which has been effective in not only improving their overall technology but also in overcoming a major barrier to pursuing sponsored research with potential industrial partners. As mentioned before, the emphasis on performance over cost was at odds with what was known in the broader scientific literature, and thus this knowledge was available to them only though working directly with Foresight.

Lastly, the Lehigh-Foresight partnership has helped them to raise the visibility of the technologies, which ultimately has led to sponsored research agreements. In the case of an enzyme-based technology Bryan and his team are developing, Foresight has been able to connect them directly to an area company who has an interest in using their technology for multiple applications. Additionally, during the on-site meeting, Lehigh and Bryan identified several other areas of common scientific interest, which has led to the potential of additional scientific consulting beyond the scope of the sponsored research centered on the enzyme technology. Lehigh and Foresight have assisted in obtaining key "gap" funding to sustain this work as well as support to travel to major conferences such as TechConnect, where inventors are able to discuss partnerships in-person with companies that had an interest in the technologies.

5 Conclusions

Within this hybrid out-sourcing model we observe the pairing of skills of the contractor and those of the TTO. By creating a stakeholder of the contractor through a trust based relationship and an alignment of interests Lehigh and Foresight have effectively balanced the internal expertise of the TTO to work with faculty and the administration with the external expertise of the contractor for effective marketing, deal making strategies as well as industry networks. Foresight as the contractor-stakeholder is able to bring to the table a team of licensing and marketing experts who have worked in various technology areas providing familiarity with the market landscape, market players, and deal structures accordingly.

The success fee-based model for deal making activities between Lehigh and Foresight has evolved to become a measured process for commercializing university technologies. Throughout the past 5 years of working together, we have seen increased success in bringing in research dollars from government agencies and industry and more traction in licensing engagements. In addition, we streamlined the assessment process allowing efforts to be dedicated to the most market viable developments. We have also seen increased participation from faculty on their understanding of the commercialization process and their willingness to engage with Foresight as an agent acting on their interest of their technology. Furthermore, we have created a buffer between the TTO and the faculty ensuring the TTO itself is not a target when propositions have little or no commercial traction. The TTO is able to have an independent voice when delivering uncomfortable industry feedback on an academic's lifelong research work. Many staff in TTOs may forget that a disclosure from an academic may be an output of a decade of work and that is akin to them handing over a child to be nurtured and looked after. It is easier to blame the third party player for the deficiency of the child rather than pretending the child has no problems. A third party can document the lack of traction, highlight the market barriers and be used by the TTO as validation for no longer maintaining the invention. Using an external contractor empowers the TTO to accept that sunk costs on precious investments should be written off.

In summary, the hybrid out-sourced model enhances efficiency of a small TTO with the take-away being the creation of a stable, scalable framework balancing the TTO's objectives and core competencies with those of an external partner, addressing the primary challenge of limited resources.

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Cooperation Between Audi Hungaria Motor Ltd. And Széchenyi István University

"The Path Is The Goal"

-Ghandi-

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Abstract

Universities as well as members of the industry have a mutual interest in forming partnerships. The benefits are obvious from both sides and summarized in this paper. The paper presents the partnership between Audi Hungaria Motor Ltd., the largest engine manufacturer worldwide, and Széchenyi István University. The paper describes the areas of common interest. The cooperation under focus was supported not only by the two participating institutions but also by the city of Győr and the government of Hungary. After describing the initial vision and a short history of the cooperation, the paper describes the actual status of the partnership and the implementation strategies applied. It introduces the related challenges and benefits that accompanied the process. Finally, the paper presents the future plans for the cooperation between Audi Hungaria Motor Ltd. and Széchenyi István University: a shared vision until 2020.

Keywords

industry university cooperation, practical higher education, engineering education, internal combustion engines, tribology.

1 Introduction

There is a general need for capable engineers around the world today and the situation is no different in Hungary. The need for engineers in Hungary comes from the industrial participants, of which one of the largest employer is Audi Hungaria Motor Ltd. (AHM). A cooperative partnership was formed between Audi Hungaria Motor Ltd. Széchenyi István University in Győr. University-Industry cooperation are not without example around the world and are described in numerous papers (Rorigez et al. (2005), Afonso et al.(2012)).

1.1 Audi Hungaria Motor Ltd.

Audi Hungaria Motor Ltd. operates in Győr, Hungary since 1993. Starting with manufacturing a 4-cylinder engine, it grew to be the largest engine manufacturing plants around the world (Demmelbauer-Ebner, W. (2012)). Besides engines, vehicles are also manufactured in Győr such as the TT, A3, S3. As manufacturing volume grew, an engine testing facility than a research and development centre were also built. Audi Hungaria Motor Ltd. had 7322 employees, the company has produced 5.598 billion euro revenue and invested 685 million euro in year 2011 (Audi Annual Report, (2011)). The same values in 2012 were: number of employees: 8663, revenue: 5.282 billion euro , and the investment was 1.038 billion euro (Audi Annual Report, (2012)). Figure 1 shows a visual aid that helps understanding the business philosophy of AHM.

Figure 1. Company: AHM is the most profitable and most flexible plant of the concern. People: the focus is on the human. Process: effective and continuous process entwicklung. Product: premium product in premium quality.

1.2 Széchenyi István University

Széchenyi István University is the youngest university in Hungary. It was as Technical Collage of Transportation and Telecommunication with two campuses, one in Budapest and one in Szeged. The college was moved to Győr at the beginning of 70's to fulfill the need of the industrial manufacturing plants of the area. The college had strong relationships with the industry from the beginnings in the fields of railway engineering, transportation engineering, automotive engineering, and telecommunications. The college rose to be a university in 2002 as the result of the dynamic development of education, research, and development. The university has not lost momentum ever since and offers bachelor, master, and doctoral degrees in engineering, law, economics, health sciences, and music. In 2012, there were 14400 students enrolled at Széchenyi István University including 2100 mechanical engineering students, of which 1100 emphasize their studies in automotive engineering. The university offers fulltime training as well as distance learning, and e-learning programs.

2 Motivation behind the cooperation

The driving forces were similar to those in the present cooperation as anywhere around the world with some specialties. The need was there from both sides Audi Hungaria Motor Kft. as well as Széchenyi István University and this need met with local and national goals.

2.1 Motivation from the side of the university

In an ideal world universities are supposed to perform research and lead the way in technical R&D. At the same time universities train cutting edge technologies to engineering students so when they get a job they bring new ideas and technologies with them from the university to their new job. Reality in Hungary in the 1990's and early 2000's was completely different. Universities taught old and obsolete technologies and methods and tried to have industrial contacts just to keep up, just to be able to teach at least what was already applied by the industry. Freshly graduated engineers had strong theoretical background but still needed much training to be able to fulfill their duties.

Laboratories at the universities were 20-30-40 years old, lots of them were out of order and there was no money to operate them.

Education was free of charge in the communist era but tuition fees were introduced in the 1990's. Tuition became a significant income of the universities therefore the number of students was raised in order for the universities to be able to survive. The he increased number of students and the state of the university laboratories caused the practical side of the training diminish.

Researchers show that industry participation has positive effects on research performed at universities. First of all industry funding has a positive effect on the research performance of university professors (Gulbrandsen and Smeby (2005)). Industry funding was scarce at Hungarian universities.

Second of all researchers also show that structured management has a positive effect on university research (Weijden et al. (2008))

All these reasons were calling for a change at Széchenyi István University.

Note must be taken that research show that besides the positive effects, there are some negative effects of industry participation in university research such as erosion of academic freedom or the jeopardy of a single financial source (Behrens and Gray (2001))

2.2 Motivation from the side of the industry

An economic stability was formed after the privatization process that followed the revolution in Hungary in 1989. This resulted in an industrial growth and spurred the need for engineers. In the 1990's companies started to locate their production lines to Eastern Europe because of the cheap labor. But because of the situation of universities, freshly graduated engineers still needed much training to be able to fulfill their duties. Industrial companies tried to compensate for this installing practical training programs as the first step of cooperation with universities.

Another challenge that companies had to face was the lack of language skills of the young engineers. Although language education was mandatory in Hungary, up until the 90's the enforced language in the school system was Russian. It did not make it easier for AHM that after the revolution mainly English was taught in the schools because the official language at Audi AG is German.

As economy stabilized AHM founded a R&D facility in Győr. In the beginning it was application development a support for production. Later they started an engine test center and a research facility. These facilities needed well trained engineers not only in production but also in research. Figure 2 more that 60% of the associates at the engine development department was university graduates.

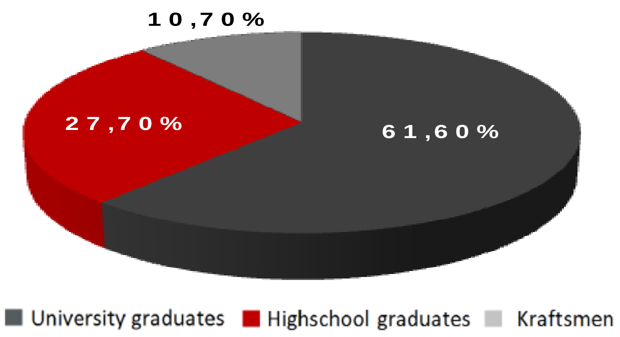

Figure 2. The compositions of the engine development department at Audi Hungaria Motor Ltd. in 2012.

2.3 Motivation from the side of the City Of Győr

The industrial activity is strong in the city of Győr and the neighboring areas. The result of the economic growth is low unemployment rates and high local taxes.

The city has about 130 thousand inhabitants, it is a nice livable place with the feeling of a small town and with lots of advantages of metropolitan areas such as cultural life, mass transportation, and a university.

The future vision about the city is not to build it infinitely larger to make it an industrial metropolis but to keep its present size and atmosphere, concentrate and keep research and development in the city, and install the manufacturing plants in the smaller towns and villages around Győr. A large percentage of the employees have to commute to work anyway so it does not make a difference if the destination is in Győr or just 30-50 km outside of Győr. It would also be advantageous from an entrepreneurial stand point because of the lower real estate prices and lower local taxes.

2.4 Motivation from the side of the Hungarian government

Audi Hungaria Motor Ltd. is one of the largest employer in Hungary contributing in large to the GDP and the national taxes.

Furthermore governmental intention is to foster research and development in the nation. Researchers show different motivation behind governmental participation in university-industry cooperation (Gander (1986)).

3 Realisation of the cooperation

The motivation was clear from all four sides: Audi Hungaria Motor Ltd., Széchenyi István University, the city of Győr, and the government of Hungary. The motivation had two sides education and research.

A new department was formed in December of 2007 as the first phase of the cooperation: the Audi Hungaria Department of Internal Combustion Engines. Beginning with six people the department started to develop an educational and a research program. The goal was the modernization of the infrastructure and the contents of the teaching. Figure 3 shows the two focus areas of the department and strategies that support these focus areas.

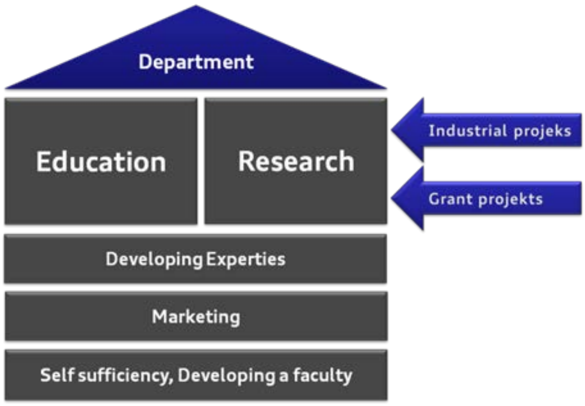

Figure 3: The Department of Internal Combustion Engines focuses on Education and Research. The goal was to develop experties, become a research service provider, and become self sufficient. To realise these goals the department needed to develop a faculty with high experties and rund industry and grant finaced projects

3.1 Educational cooperation

The department became responsible for teaching the internal combustion engine related subjects for both B.Sc. and M.Sc. students.

(1) Internal combustion engines M.Sc.

AHM expressed need for master level engineers for the new Audi engine development facility. To fulfill those needs an M.Sc. program was developed and started at the department. This was in harmony with the request from the university leadership to offer more M.Sc. programs. The internal combustion engine M.Sc. was and is German language centered to fulfill Audis need for German speaking engineers. The program started as partially German in 2009 with the basic subjects being taught in Hungarian and the engine specific subject in German. In 2012 24 students were enrolled in this program. In 2012 the same training program also started in German language only where every subject is taught in German. Figure 4. shows the curriculum of the M.Sc. Program. The internal combustion engines M.Sc. program consists of higher level science subjects (blue), engineering subjects (red), and internal combustion engine related subjects (yellow) in about equal amounts. The training program is four semesters long with the fourth one being free of taking subjects so that students can work on their final year project and thesis abroad in any Volkswagen AG facility.

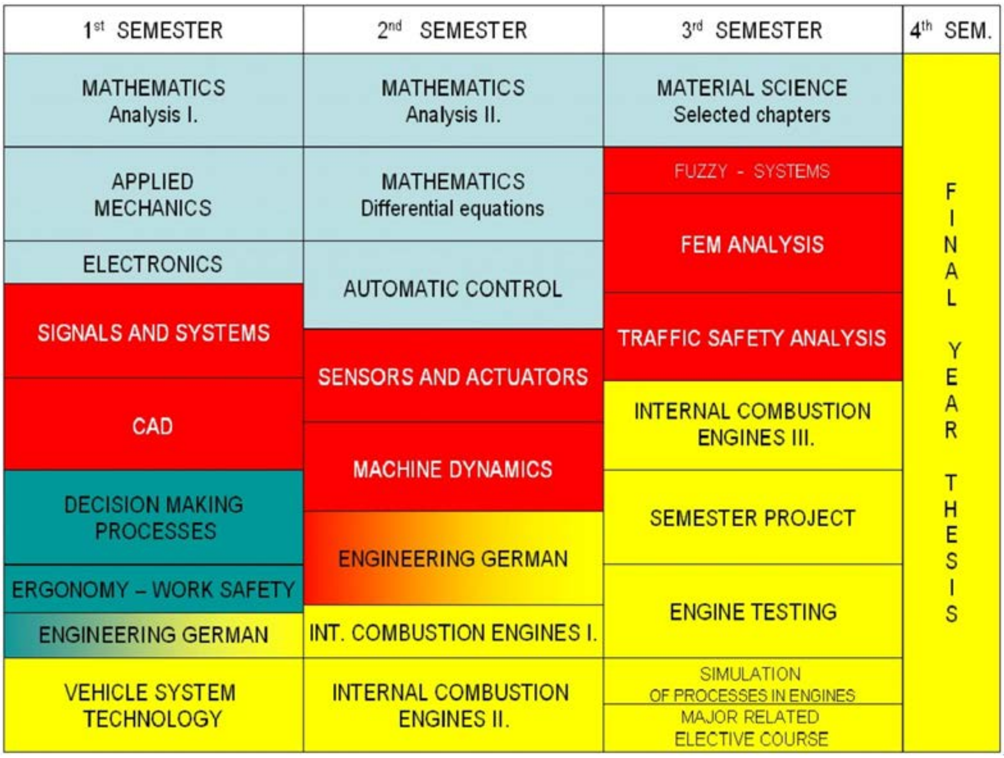

Figure 4. The internal combustion engines M.Sc. program consists of higher level science subjects (blue), engineering subjects (red), and internal combustion engine related subjects (yellow) in about equal amounts. The training program is four semesters long with the fourth one being free of taking subjects so that students can work on their final year project and thesis abroad in any Volkswagen AG facility.

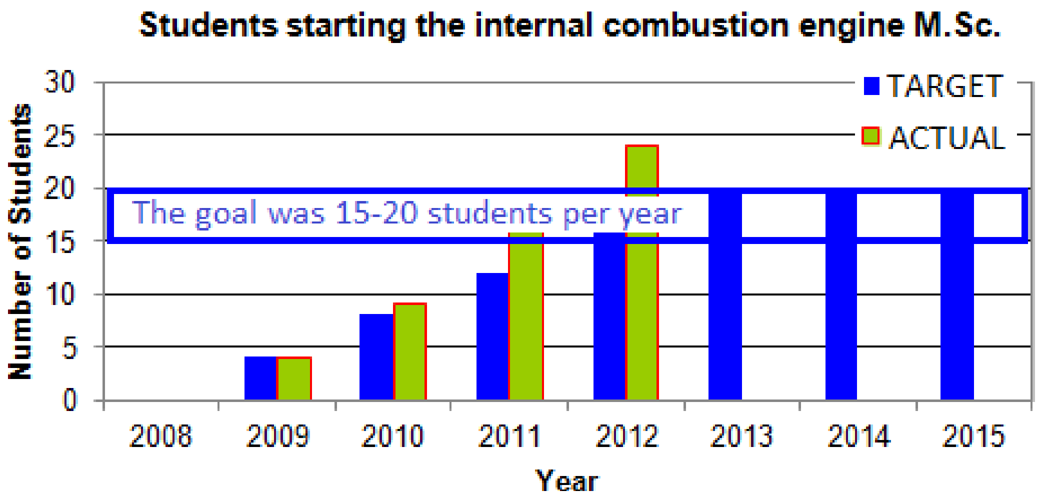

Figure 5. The development of the number of students starting the internal combustion engine M.Sc. The planned value of 15-20 students per year after 4-5 years was exceeded in the fourth year, 24 students were enrolled into the program.

The M.Sc. program was started in 2009 with only four students and progressively developed as Figure 5 indicates it. The planned value of 15-20 students per year after 4-5 years was exceeded in the fourth year, 24 students were enrolled into the program. Figure 6. shows the composition of students participating in the internal combustion engine M.Sc. program.

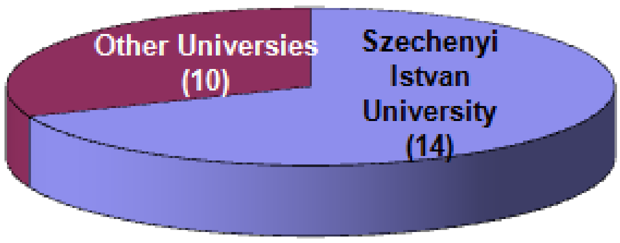

Figure 6. The composition of students in the internal combustion M.Sc. program in 2012 was 14 students from one of Széchenyi István Universitys B.Sc. programs and 10 students from other universities in Hungary.

(2) Internal combustion engines lacture series

The Department of Internal Combustion Engines organizes a series of lectures on the topic of internal combustion engines. The informative lecture series takes place every even Thursday of the semester where lecturers from different engine related fields present topics from their expert field. Some of the topics covered were development of a V6 engine for a motorcycle, combined roll/slide bearing development for engine crank shafts, or the engine development of the Bugatti Veyron. Figure 7 shows the topics covered during the spring semester of 2013. The medium of information flow is off course in German.

Thema	Datum	Vortragende	Ort
Antriebskonzepte von Volkswagen für eine nachhaltige Mobilität	2013-02-21	Dr. H.-J. Neußer (Konzern Aggregateentwicklung VW)	Foyer MT Universität
Motorentwicklung in der Formula Student – unser erster Einzylinder	2013-03-07	SZEngine (Formula Student)	Foyer MT Universität
150 Jahre Elektromobilität „Als der Strom zu fahren begann"	2013-03-21	Brigadier Prof. G. Hohl (ÖVK)	Foyer MT Universität
Gießtechnik Motor – Innovation in Großserie	2013-04-04	Dr. R. Viets (Gießtechnik Audi)	Foyer MT Universität
Innovation Range Extender – Auslegung und Nutzen	2013-04-18	D. Janetzko (AVL Budapest)	Foyer MT Universität
Alternative Kraftstoffe bei Pkw – Chancen und Herausforderungen	2013-05-02	Dr. M. Lohrmann (Forschung VW)	Foyer MT Universität
E-Learning / Mobiles Lernen	2013-05-16	C. Freundl, A. Farkas (Audi Akademie)	Audi Akademie
Presswerk der Audi Hungaria	2013-05-30	G. Hofweber (Presswerk Audi Hungaria)	Audi Akademie

Figure 7. Topics of the internal combustion engine lecture series in the spring of 2013.

(3) Győrer Tribology Symposium

One main goal of the department is to cultivate a technical culture in the region. Part of this effort is the Győrer Tribology Symposium. The symposium is a technical conference that the department organizes every two years. Presently the third Győrer Tribology Symposium is being organized. Figure 8 and 9 show information about the 2nd Győrer Tribology Symposium.

Figure 8. The 2nd Győrer Tribology Symposium

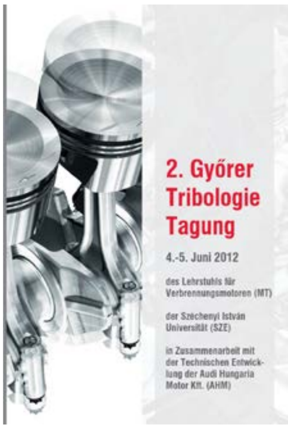

Figure 9. The flyer of the 2nd Győrer Tribology Symposium

(4) Audi involvement in the higher education

Audi Hungari Motor Ltd. gets involved in many ways into the training of the students at the university. One example is the involvement of the AHM Projet Office into project work, team development and project management related topics. AHM metods are taught and AHM culture is cultivated already during the university years of the future engineers. This prepares them to work for Audi Hungaria Motor Ltd.

(5) University involvment in Audi trainings

The Department of Internal Combustion Engines is involved in the lifelong learning process of AHM. The educators of the university teach engine related subjects to all levels of Audi associates.

(6) Formula student team

Practice and hands on education make a real engineer. That is exactly the kind of training that the formula student team ensures to its team members. The formula student team at the Department of Internal Combustion Engines of Széchenyi István University does not build a race car. They design and build an engine optimized for the vehicles participating in the formula student competition series (Formula Student competition series of the Institution of Mechanical Engineers (2013)). Figure 10 the engine that was designed and built by students involved in the Formula Student competition.

Figure 10. The engine designed and built by the Formula Student team at Széchenyi István University. The engine is 500cc, single cylinder, optimized for formula student race cars.

The team is sponsored by several industry participants in the area such as AHM, Bosch, Nemak, etc.. Extracurricular activities like Formula Student give students a knowledge that they cannot get in the class room. They also become enthusiasted and motivated to learn engineering when they see the application of what they learn. That is how they learn that engineering students have to work hard for 5 years so they can play for the rest of their life.

A scientific way for the students to exchange their inventions and ideas is the Formula Student Engine Symposium organized also in Győr that happens every year. Győr also gives home to a Formula Student competition.

3.2 Research and scientific cooperation - Tribology

The expectation to decrease CO2 emissions and improve fuel consumption of a vehicle is higher than ever. Besides combustion inefficiencies, friction loses are significant in terms of engines that cause significant CO2 emissions.

Decreasing friction inside the engine that causes CO2 emissions was a common interest of Audi Hungaria Motor Ltd. and the Department of Internal Combustion Engines. That is why the main direction of research of the department was defined to be tribology. Tribology is the science of friction, wear and lubrication, which are present in every situation of life. The laboratories of the department were established with a focus on friction, wear and lubrication. The new laboratory building was inaugurated in April 2011 and the office building was inaugurated on the 2nd of May 2012.

Figure 13 shows the office building (red) and the laboratory building (silver) of the Department of Internal Combustion Engines.

The laboratories include a large variety of friction and wear measuring devices starting with pin-on-disc tribometers and alternating tribometers, ranging through a friction measuring cold test dynamometer, all the way to a full functional engine dynamometer for engine testing. Figure 11 shows the engine dynamometer with an Audi V8 engine on.

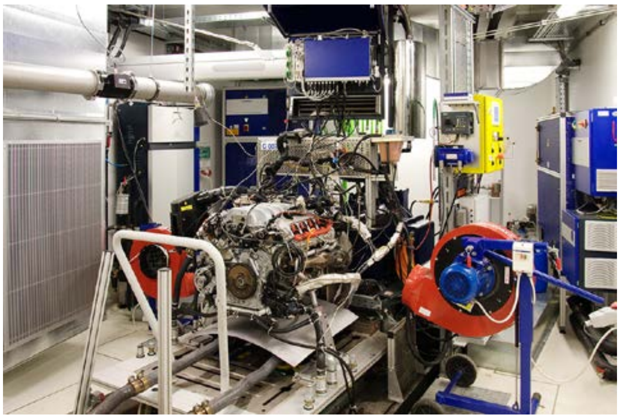

Figure 11. The full functional engine dynamometer

The laboratories are complete with a microscope laboratory for surface analysis. The laboratory consists of white light interferometer, stereomicroscopes, and a portable digital microscope. The microscope laboratory supports the surface wear experiments as well as performs component failure analysis. Figure 12 shows a picture of the microscopy laboratory.

Figure 12. The microscopy laboratory.

One special equipment at the department is the online wear measuring device that uses radionuclide technology (Gergye and Dreyer (2012)). The equipment is capable of measuring wear online accelerating wear measurement in an engine significantly.

Another special equipment is the particle image velocimeter (PIV). The PIV equipment is to study flow. It uses an optical method to visualize flow situations.

Laboratories were designed and constructed to meet international standards. At the same time an important requirement was to be compatible with AHM laboratories. Although Audi Hungaria Motor Ltd. is the largest customer of the department, the goal is to have a variety of customers and provide service to other automotive manufacturers and their suppliers.

Figure 13. The office buildings of the Department of Internal Combustion Engines. The office building is red and the laboratory building is silver.

4 Finances

The buildings and the laboratory equipment cost 8 million euro. The laboratory and office building and the office equipment were realized on a combined budget of four participating parties:

(1) Széchenyi István University

(2) Audi Hungaria Motor Ltd.

(3) City of Győr

(4) Grant money from the Hungarian government.

Each of the participating parties paid about one quarter of the total costs.

One of the goals of the department was to become self sufficient and financially independent i.e. to operate as a nonprofit service provider to the industry. It can only be realized through running a sufficient number of projects to support all the financial needs of the department. In order to reach that goal al the technical equipment is available.

5 Challenges

5.1 Cultural differences

The expected advantages of the university-industry cooperation were clear from the beginning. However, the project faced some challenges as the participating parties gathered from different backgrounds and different cultures. Audi Hungaria Motor Ltd. has a firm structure of management, the job description of employees is clearly defined, methods are well worked out, and everything is goal oriented and functions with the profit and cost reduction in focus. As opposed to that in a government controlled organization as the university methods seem to be process oriented, job descriptions are obscure and the university employees want to keep their academic freedom.

5.2 Burocracy

The burocratic ways of handling affairs and slow decision making processes of government institutes is just the opposite of that by AHM.

Just one example the open application and fair selection process of suppliers, planning and construction companies that is mandatory when the university wants to build something consumed about one third of the project period costing much time and energy before even planning would be able to begin. The aim of these complicated processes is to prevent corruption but at the same time makes project preparation cumbersome and expensive. Besides increasing the complexity and cost of a project it also brings the few eligible companies into monopole situation that is disadvantageous for once they are selected there in no way to change them.

5.3 Faculty and staff

Once the laboratories were installed competent faculty and staff were needed. At the moment the department has:

3 Associate professors

1 Assistant professor

2 Ph.D. students

3 Research engineers

1 Secretary

The present staff is far from being enough to operate the existing equipment. the strategy of the department is to involve students into research projects. Students like participate in the research projects because the topics are interesting real life situation and it also gives an opportunity to the students to earn an income. Besides the students applied the department currently has open positions at the levels of associate professor, assistant professor, research engineer, and Ph.D. student.

5.4 Communication

Proper communication between the university and Audi is very important. To ensure proper communication a liaison person was applied; the head of the department has a double position. He is the head of the department at the university and he is the manager of research and university projects at AHM. He is a full person at AHM as well as at the university. He is regarded as an internal associate at both institutions. Having a liaison person between AHM and the university who understands both systems and considered an insider makes communication and decision making faster.

6 The Present Situation

Cooperation has started in mid 2011 when the laboratories were finished. The first mutual projects were successful and the cooperation proved to be advantageous for all participating parties. Based on the positive experiences from the cooperation other departments that focus on scientific areas of Audi interest also got involved in the existing partnership between Audi and the University. Thus the Audi Hungaria Vehicle Engineering Department Group was founded. The department group includes three departments: the Department of Material Sciences and Technology, the Department of Vehicle Manufacturing Technologies, and off course the Department of Internal Combustion Engines. The scientifically mutual focus area of the three members of the department group is tribology: friction, wear, and lubrication.

The Department of Material Sciences and Technologies focuses on developing new materials and component pairs, and surface coatings. The Department of Vehicle Manufacturing Technologies develops production technologies and surface manufacturing technologies for the component pairs that undergo friction and wear. The Department of Internal Combustion Engines makes the tribologic testing of material pairs, component pairs, and the complete engines for friction and wear.

7 Conclusions / the shraed vision until 2020

The paper presented the partnership between Audi Hungaria Motor Ltd., and Széchenyi István University. The paper described the areas of common interest. The cooperation under focus was supported not only by Audi and Széchenyi István University but also by the city of Győr and the government of Hungary.

After describing some history of the cooperation, the paper presented the actual status of the partnership and the implementation strategies applied. It introduced the related challenges and benefits that accompanied and maybe accompany still the cooperation.

It can be concluded that although cultural differences between industry and the university, the burocratic difficulties in Hungary, and communication problems presented some challenges, the cooperation was successful and started an ongoing growing process that is becoming stronger and has more and more linking point between Audi Hungaria Motor Ltd. and Széchenyi István University.

The next step of department group development is to involve the Department of Vehicle Design, that would incorporate all the departments that are vehicle related.

The participating departments have developed a shared vision with the goal of forming the Tribology Competence Cluster of Győr. The vision is to become a major tribological research center of the area that is known world wide, focusing on but not limited to internal combustion engines. Figure 14 shows a visual aid that shows the three departments forming the department group and their mutually interesting research area: tribology.

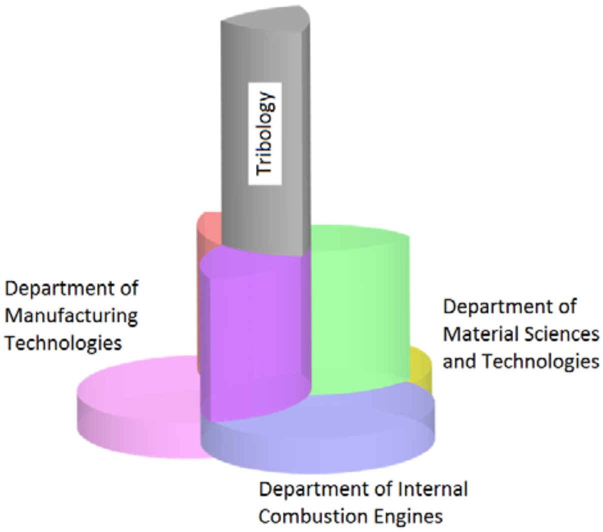

Figure 14. The main focus areas of the three departments have intersecting regions. Tribology is the area that is present in the scientific interest of all three departments.

Acknowledgements

Special thanks to the people behind the participating organizations whose motivation made this cooperation happen.

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Improving Efficiency & Effectiveness Of Small Academic Technology Transfer Offices (TTOs)

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Abstract

Academic Technology Transfer Offices (TTOs), especially small tech-transfer offices have traditionally faced many challenges in trying to transfer university inventions from the laboratory to the marketplace. One of these challenges is to identify appropriate internal and external resources that could assist the TTO in managing the invention disclosure pipeline received by the office. Lehigh University's (LU) TTO (which is a relatively young and small office) has identified appropriate partners to manage the invention disclosure pipeline and develop strategic tech-transfer partnerships, especially on the patenting side with intellectual property management law firms, and marketing side with commercialization/licensing firms.

This paper will address the strategic path adopted by LU TTO to steadily identify and develop appropriate partners in the tech-transfer supply chain, which in turn has assisted in improving the tech-transfer efficiency and effectiveness. Intellectual Property protection and marketing/commercialization of inventions are two very significant components of the tech-transfer (TT) supply chain. This paper will focus its discussion on the partnerships in these two specific components of the tech-transfer process, while also addressing some other collaborative efforts. One of the authors (Kurt Ehresman representing Rhoads & Sinon) will focus on the intellectual property protection component, while the other author (Claire Gaudreau, representing Foresight Science & Technology) will focus her attention on the commercialization component of the tech-transfer supply chain partnership. Rhoads & Sinon has expertise in all legal aspects of intellectual property, and Foresight has been a market leader in technology commercialization and has a wide connection into the industry market sector wherein it has successfully assisted several companies and government agencies' in the technology commercialization arena. It is this combined expertise that needs to be applied towards academic TTOs and analyze the potential of this approach for enhancing success of small university TTOs.

The authors and their organizations have slowly but steadily developed a rather unique relationship and model that promotes and highlights the roles in a successful collaborative effort to assist small TTOs in academic technology transfer. A similar model could be adopted by other small TTOs, with room for flexibility to form unique partnerships within any university setting to successfully shepherd intellectual property (IP) from the academic laboratory, through a modest TTO office, and to the marketplace – yielding a very efficient, cost-controlled successful technology transfer practice.

Keywords

Technology Transfer, Lehigh University, Intellectual Property, Inventions, Academic, Partnership, Commercialization, Licensing.

1 Introduction

Technology Transfer is a process that needs the right resources for effectively moving technologies to market. It requires a team of experts with roles in legal, scientific, and business under a formal mechanism to transfer knowledge and innovation from academic research instiutions (not-for-profit) to the private sector (for-profit) for commercial application and public benefit. While academic/university Technology Transfer Offices (TTO) embody the basic mechanism, having all the components collected under one roof, operating in a cohesive direction is not always the case, especially for institutions with small and/or emerging offices, as is the case with Lehigh University (LU) TTO. In addition, there needs to be an established plan of action for completing each phase of the commercialization process, which can also be difficult for these same institutions (TTT 2009).

In its simplest form, an academic TTO's two primary objectives are to protect and license IP. In other words, it is important for TTO's to address the primary compontents of "patentability" and "marketability" for which appropriate expertise is needed. Small TTO's that are constrained by both, operational and staff budgets and other resources, find it extremely difficult to address these components of the technology transfer supply chain. This affects the TTO's efficiency and effectiveness and creates a need to identify appropriate internal/external partners to fulfill the roles of these components.

This paper addresses the challenge of small TTO's in patentability and marketability functional areas and offers a model that utilizes the appropriate partners to assist the TTO in managing the invention disclosure pipeline efficiently and cost-effectively. The sections within the paper will focus its discussion on the partnerships developed and outline a novel approach to source an experienced team in order to leverage the necessary skills for a cost effective solution for small TTOs with limited budgetary resources.

The paper is structured in five sections; Section I is the Introduction; Section II is a brief background and need for developing partnership assistance in IP protection and marketability; Section III is the discussion on the patent firm partnership; Section IV is the discussion on the marketing firm partnership, and Section V is the Conclusion providing the advantages of this model's technology transfer supply chain partnerships.

2 Background & need

Technology Transfer has increasingly become an important means of advancing and disseminating academic-based innovations to the private sector and to the general public. Universities as engines of economic growth, via the commercialization of university generated IP have captured the attention of academic administrators as well as policymakers all over the world (Bozeman, 2000, Crow & Nath, 1992 and Poygo-Theotoky, J. Et al, 2002). As a result, the generation and exploitation of IP has become a central issue not only for the universities across the United States, but it is also a major driver for government policy in and related to technology transfer issues (Sharma et al, 2006) . Since the passage of the Bayh-Dole Act of 1980, universities have been an increasing resource for technology-based economic development through the transfer and commercialization of university IP. An increasing number of universities are defining their institutional objectives in terms of identifying, creating and commercializing IP being created on their campuses. Technology Transfer is the creative means of connecting the university ideas to the real-world industry public use.

The objectives of the TTO are to contribute to the economy, facilitate research uptake for the public good, provide IP protection for inventions stemming from the research, develop mutual beneficial ties with the industry, motivate and retain academic staff and ultimately to increase income to the universities (Ustundag, et al, 2011). But many small TTO's have existed for less than 10 years and hence not produced a strong revenue stream yet (Trune & Goslin, 1998). An often quoted rule of thumb in the TT professional circles suggests that even under the very best circumstances, TTOs do not become successful for seven to ten years after they have been established (Young, 2007). In fact, according to Lita Nelsen, MIT TTO Director, it takes eight to ten years for a TTO to stop losing money and nearly two decades for it to make any significant impact to the local and regional economy (Nelsen, 2007). More than 50% US TTOs lose money, 45 % just about break even and the remaining 5% are the ones that make most of the licensing revenue (Heher, 2007). Looking at these numbers, it is a given that most university TTOs cannot be self-sufficient and hence are not on the most-favored list of university budget administrators. In addition, another challenge facing the TTOs is deciding which inventions to protect and to what extent. No office has the resources to patent all inventions, especially if they are not likely to generate revenue for some time, if at all. As a rule of thumb, ten invention disclosures may lead to one patent, and one license might come from ten patents. In other words, only 10% of patents provide royalties (Nelsen, 2007). It is critical, therefore that the TTO invest in only those inventions that are both, truly innovative (patentability) and also appear to have commercial value (marketability). Remember, the goal is to not simply patent inventions, but to strategically patent inventions that have commercial value. Given that small TTOs face the additional burden of limited operational and staff budgets, it is imperative that they think of creative means of performing their daily TT functions and focus their efforts primarily on a combination of patentability and marketability functions.

The primary role of the TTOs has been to protect the growing IP of universities and to act as a facilitator between faculty inventors and industry for effective technology commercialization (Owen-Smith, 2001). It is clear by now that there is a need to have expertise both in IP protection and IP marketing. But a growing consensus in the academic circles states that TTOs lack the resources and competencies necessary for effective and efficient TT, especially the staffing component (Tornatzky, 2000). According to Sigel et al (2004), most universities have recognized the importance of TTOs and established their own offices after the Bayh-Dole Act of 1980, without adequate and appropriate staffing capacities. It seems that universities need to be made aware that human infrastructure is even more important than physical infrastructure. A TTO needs to have employees with primary experience in IP protection and business development, in addition to other functions of the TTO. Given that universities are not devoting adequate resources towards the TTO functions, it is imperative that TTO's find unique and creative ways to perform their respective functions by identifying appropriate partners within the TT supply chain. LU TTO has managed to partner with several such entities given its limited operational and staff budgets. This paper focuses on 2 such partnerships, one on the IP Protection (patenting) side and the other on the Business Development (marketing) side.

Patent Partnership Need - IP Management is integral to the TTO and integral to this is the patenting. The optimal value and scope of the IP embedded in innovative technologies will be greatly affected and influenced by the quality of the patent coverage, which in turn is influenced by the quality of work done by the outside patent counsel. It is therefore essential for a TTO to select a patent attorney whose work will enhance the inventions prospects of licensing. From selecting to hiring to ongoing interactions, it is important for the TTO and the patent counsel to develop and maintain a good working relationship. Central to this relationship is ensuring that the patent counsel can prepare and prosecute patent applications in a manner that achieves positive results, cost-effectively (Goldman, 2007). In addition to providing services in the areas of patent, copyright, trademark, the patent counsel can provide various other services such as general counseling in inventorship issues, provide license, valuation and agreement support as well as startup formation and dispute resolution assistance. By selecting an appropriate patent counsel, the TTO can ease its workload and facilitate one of its primary mission of IP protection. Therefore, retaining a skilled patent counsel and one that is well-suited to the particular needs of the TTO is an essential element of operating a viable, efficient and cost-effective TT program.

Marketing Need – If patenting is on one side of the IP management coin, marketing is on the other side. Without a deeper and clearer understanding of the market landscape and industry needs, patents cannot find their way to the market. It is imperative to keep in mind that the so-called innovation has no value until it has been licensed by a company for further development and commercialization or a new company is formed about that technology. In addition, for small TTOs with a one-man army to manage the office, the breadth, expertise and time doesn't exist to reach-out to the different industry contacts and form the appropriate linakge between the technology and the user. It is important to attract the right licensee by placing the right information in the right hands of the right companies at the right time. Significant time, knowledge and network is needed for this functionality to happen successfully. Hence, it is imperative for the TTO that is confined by lack of resources, to make attempts to identify successful marketing/commercialization experts, especially in the academic technology transfer space and engage them actively in marketing and licensing university technologies to the appropriate industry partners. Developing and maintaining an effective, long-term relationship with a marketing service provider is very important, especially when considering the amount of time necessary to commercialize the early-stage business opportunities created at most universities.

3 Patenting partnership

In order to meet the Patent Partnership Need, a small TTO needs to identify a licensed patent professional who is truly committed to the cause of building a high-quality IP portfolio within the cost structure of the TTO. By selecting an appropriate patent counsel, the TTO can ease its workload and facilitate one of its primary missions (IP protection). Therefore, retaining a dedicated, skilled patent counsel is an essential element of operating a viable, efficient and cost-effective TT program

In the authors' collective experience, the best place to start searching for such a truly committed individual is within the University's alumni network. Alumni within the University's network are most likely to understand and share the University's cultural leanings and non-profit mission, and to be enthusiastic about contributing to the University's present and future successes. That understanding, shared culture, and enthusiasm can help to ensure that the TTO, as well as the inventors, receive high-quality, responsive advice, and top-shelf quality patents.

In the instant case, when LU was forming its first TTO, several alumni and non-alumni patent professionals/attorneys expressed interest in providing services. Each professional was a licensed patent attorney with many years of experience with a reputable Pennsylvania law practice, and each enjoyed a different scientific background. Because of this strong initial group, and in view of the relatively modest number of invention disclosures expected in the first year of TTO operation, the University decided not to undertake a formal Request for Proposal or bid process. Rather, each patent firm was given the opportunity to propose its terms for possible representation in patent matters, and the TTO was given freedom to negotiate terms. Those firms who offered reasonable terms were given initial projects over the course of the TTO's first year of operation. At the end of the first year, each firm was evaluated for their quality of work, responsiveness, cost, and efficiency. As a result, beginning in year two, the TTO began to focus on the firms with the best proven performance, giving those firms proportionally more work, while continuing to monitor and evaluate the results.

By year three, the TTO had firmly established a solid working relationship, primarily with 2 patent firms, each with a different cost model. One firm provided its work on an hourly rate basis, providing non-binding estimates of costs for each new case and task. The other firm provided a capped fee structure by providing binding estimates for each task involved in patent prosecution. Over time, the capped fee structure naturally became the TTO's preferred cost structure, because it allowed the TTO to accurately budget for patent matters. Kurt Ehresman, (one of the authors and a very dedicated and committed Lehigh Alum), whose firm Rhoads & Sinon (R&S) offered the capped fee structure, noticed an increase in the proportion of work received by the firm from the University, which in turn helped to convince the firm that any "risk" in offering capped fees was justified.

From year 3 to year 5, Mr. Ehresman continued to offer patent prosecution services on a capped fee, task-by-task basis. When R&S noticed that their portion of all patent work from the TTO during that period more than doubled, they knew that the relationship was solid and stable, and mutually beneficial. Because the University did not want to pursue an exclusive relationship with any one firm, R&S knew that they could not obtain all the work, and other firms continued to receive about 25% of the patent work on a regular basis. With a solid track record based on capped fees per task, R&S could have stayed the course indefinitely. But as a dedicated alumnus, Mr. Ehresman knew that he could improve the system further. And so he made a new proposal to the TTO that remains in force today, and one that R&S has used successfully with 14 other Pennsylvania colleges and universities. That proposal involves a complete schedule of fixed fees for every routine patent task, whether US, PCT, or foreign.

R&S's schedule of fixed fees for patent tasks is simple, and allows a TTO to plan its budget for each patent case well in advance of each task. The schedule groups all patent tasks that occur at any given stage of prosecution, and provides a fixed fee for that entire task grouping. For example, US Provisional Applications involves: an inventor meeting, review of the invention disclosure and any prior art known to the inventors, drafting and assembly of the provisional (cover-page) application, sending to the inventors for comment, and filing. As of 2013, the fixed fee for that entire task group is $750, plus the USPTO provisional filing fee. Likewise, the fixed fee for all tasks involved in a patentability study (whether done before or after the provisional filing) is $750. Utility patent applications tasks are currently billed at $6,500 plus the USPTO or WIPO filing fee. The fixed fee for all tasks related to responding to a First Office Action is $2,500, while all tasks relating to a Second Office Action being just $1,500. Additional fixed fees in the schedule involve After-Final Responses, Interviews, Appeals, attending to Notices of Allowance and Issue Fees Due, and post-grant Quality Reviews.

While fixed fees have been exceptionally well-received by university clients, they are even more useful when paired with docketing reports that identify the timing of expected tasks over the TTO's fiscal year. Accordingly, R&S routinely generates client due-date docket reports looking at least 6 months out. For tasks due within 3 months, as well as for new unfiled cases, R&S also prepares a Current Tasks and Projects spreadsheet. That spreadsheet identifies: 1) the TTO case number; 2) our case number; 3) the inventor names; 4) the task and its due date; 5) the status of the task and items needed;

and 6) the cost of the task, per the fixed fee schedule or binding estimate for items not on the fixed fee schedule.

Last, but not least, the R&S law firms' service to the TTO involves regular visits to the university, at their cost. Typically, the attorney visits at least twice a month, for a half-day each visit. Those visits provide a great opportunity to meet face to face with university inventors, as well as TTO staff. However, the greatest advantage has been the opportunity to conduct well-planned telephonic interviews with USPTO patent examiners, while sitting in the same room with the inventors and our TTO clients. Such interviews have yielded dramatic improvements in the quality of the University's patent portfolio, by increasing the rate of allowance, the number of claims allowed per patent, and by reducing pendency and increasing patent term adjustments in the University's favor.

In addition to providing services in the areas of patents, copyright, trademark, the patent counsel can provide various other services such as general counseling in inventorship issues, provide license, valuation and agreement support as well as startup formation and dispute resolution assistance. Another benefit of involving an IP professional who is part of the Alumni network is that it creates real opportunity for communication with other Alumni concerning the University's IP Portfolio and available technologies for licensing and commercialization.

As you can imagine, not every lawyer or every firm will even consider fixed fees, free campus visits, or many of the other hallmarks of the plan. But for firms who have dedicated alumni patent professionals, it is something to consider. And for TTOs who need quality and loyalty at a controlled cost – we suggest that your alumni network is the best place to look. If the authors' collective experience is any indication, you will find somebody who is dedicated to giving back to their alma mater, and who will bend and flex the typical law firm fee structure to your benefit if you treat him/her right.

4 Marketing partnership

In order to accomplish the marketability aspect of successfully commercializing technologies within small TTOs, a relationship with Foresight Science & Technology (FST) was established. Originally the relationship existed to accomplish the undertaking of assessing technologies from a market perspective. It is important to note that the assessment is on the market viability, not from a freedom-to-operate perspective as these are separate issues to be dealt with by patent attorney. This step in the commercialization process provides an overview of the market, its drivers, barriers, players and pull for the technology area in order to determine if the novelty (as determined by the intellectual property component) is desired by end users. The end deliverable of this assessment process creates the base for the marketing strategy outlining the end user needs (i.e. obtaining the voice of the customer).

By sourcing to a stakeholder like FST to complete this activity, known as the Go/NoGo phase, we are utilizing an early stage weeding tool, designed to rapidly and cost-efficiently identify showstoppers to commercialization before resources are spent on a technology which may be unlikely to succeed. This task saves the TTO valuable time in determining what technologies to move forward with in patenting and marketing and highlights the beginning processes for the action plan for commercialization. The stakeholder's expertise is leveraged, limiting costs to the TTO as they eliminate the need to have a full-time employee and databases in-house while attaining competency for the marketability of a technology. In addition, LU and FST were able to negotiate discounted pricing for each technology assessed (and other deliverables) knowing that down the road if the technology was interesting enough, FST could play a more involved role in deal making. This theme of balancing expertise, resources and costs will be echoed throughout this paper. And to continue with this premise, we will talk about the evolution of the relationship between FST and LU as it grew beyond this initial market validation phase leading into deal making.

As technology assessments were provided for the invention disclosures that flowed through LU and the beginning of the strategic commercial pathway became clearer, there was still an unmet need to fully embark on that path. As a commercialization firm with expertise in marketing, FST saw it could fulfil this stakeholder role in the technology transfer supply chain. This stakeholder needs a wide connection with industry participants, access to networks and the know-how to properly present the technology to the marketplace, all of which may fall outside of a small TTO's core competencies.

The strength of the stakeholder is their understanding of the marketplace which allows them to represent the technologies to buyers, funders and potential licensees (i.e. targets). This involves marketing expertise, industry experience, and access to network to be successful, which again are not mainstays for the TTO. Out-sourcing the outreach to a stakeholder provides a more enhanced understanding of the voice of the customer (originally identified in the initial marketability phase we discussed earlier) to better engage with targets and develop long-term relationships. It also helps assess industry traction, as marketing is conducted to ensure that valuable monetary resources are not wasted on technologies with no market pull. In addition, these efforts for relationship building with industry are important for early stage technologies often seen coming out of universities. Through this stage the stakeholder is providing to the TTO potential partners to advance the technology readiness level (NASA, 2013) and outlining the evaluation criteria as seen by industry to further increase the commercialization success for technology.

As the connections with targets become established, FST as a stakeholder is developing warm leads to present the TTO technologies. The stakeholder is able to utilize their knowledge of the due diligence process for industry interest to attain champions for the technology and facilitate the correspondence between the TTO and the target. This allows the TTO to focus its efforts on in-reach to the faculty/inventor for delivering the necessary information to further engage the interested target. We are once more highlighting the need to divide the labor of the commercialization process for efficient and effective results.

This technique of marketing technologies also requires access to other mediums such as social media, conference attendance and face-to-face meetings with established investment contacts. Again, these are typically best sourced to a stakeholder as employing these mediums requires marketing expertise and an understanding of what channels are most effective to reach the appropriate target audience. As we mentioned in the Go/NoGo phase, here we are once more reducing costs to a TTO by eliminating the need for a full-time marketing associate and the in-house staff can focus on the day-to-day operations of the TTO.

The outreach process and the expertise required is often overlooked in terms of being a vital step in securing development funding or a license for university technologies. Using a stakeholder like FST allows resources to be allocated more effectively to conduct outreach and leverage networks to secure target engagement. A key aspect of this model that makes the approach cost effective is the success fee basis. FST's outreach efforts are remunerated based on funds received by the TTO from a target. The objective between the stakeholder and TTO are aligned and up-front costs are reduced on relatively high risk technologies still in the very early stages of development. FST's suggestion and agreement by LU for a success fee based model was the first time it was tested on a large scale with a university in FST's history.

The success fee model created between LU and FST was further enhanced to assess the traction made during the outreach process at specific milestones in development and/or at the end of a designated timeline. Because the stakeholder is a for-profit company and it is understood not all university technologies will reach a successful deal or become funded, there is a need to set these boundaries for ending outreach efforts or re-addressing them at a later point in time. As such, FST's outreach efforts in their stakeholder role are conducted in six month cycles, at the end of which we look at the traction obtained and the barriers we've encountered. These factors determine if another six month cycle is warranted, if the efforts should be abandoned or if re-engagement at a future time is necessary once the market environment is friendlier. This reiterates the idea of controlling costs and resources.

This model, now focusing on the marketability aspect of commercialization, should be seen as balancing the internal expertise of the TTO to work with faculty at obtaining disclosures, educating them on technology transfer and fostering development for more innovative technologies, with the external expertise of the stakeholder for effective marketing strategies and valuable industry networks. FST as a stakeholder is able to bring to the table a team of licensing and marketing experts in various fields to assist in commercialization deal- making. The stakeholder expertise is also used in grant proposal development as they can assist in showcasing to the funding organization the preferred commercialization path and likely potential for commercial success. This can be invaluable to small TTOs, since it would complement the internal expertise of their technology transfer professionals who may not have access to individuals in a particular technology space and are not always familiar with the deal structures, parroting the theme of balancing expertise, resources and costs.

As a summary for the marketability aspect of commercialization within this model, we see how in-reach and access to technologies as conducted by the TTO is paired with out-reach and deal making by the stakeholder. This allows for meeting the TTO's mission of faculty engagement, IP management, and increased deal intelligence for more effective marketing, ultimately resulting in maximum utilization of IP and return on investment.

5 Conclusions and recommendations

Successful Technology Transfer is not dependent on any one factor, but instead on the confluence of multiple factors inside and outside of the academic institution. Technology Transfer (and hence patentability and marketability) is as much an art as a science, and relationships/interactions between the various TT supply chain players (inventors, attorneys, marketing firms, industry, etc.) are key to achieving success. Commercializing IP developed at the university in an efficient and cost-effective manner is a key measure of providing excellent service to the university community.

It is not only important to strategically identify and select an appropriate IP law firm, but also engage the firm on the most favourable terms to the university and promote relationships on well-defined expectations, reliability and effective communication. The interaction and relationship between the TTO and the law firm is dynamic, one that constantly needs to be evaluated and monitored, both for its efficiency and cost-effectiveness. Strategic communication techniques must be used to build trust between the parties, which is very important when collaborating in an uncertain and changing IP environment. The patent attorney has a special relationship with the TTO, which should be used as a valuable resource to deal with difficult and delicate matters within the TT supply chain. Alumni patent professionals have an even stronger connection to the university, making them preferable as outside counsel for IP matters. Attorney privilege is a legal strength inherent in all outside counsel relationships, and that should be used to the TTO's advantage.

Monetizing IP has its unique challenges, not the least of which is trying to market undeveloped (and therefore, unproven) technology. The intangible and uncertain nature makes finding companies to develop such technology difficult, and yet critical to bringing the technology to market. The success fee based model for deal making activities between FST and LU has evolved to become a measured process for marketing and commercializing university technologies, while working hand-in-hand with the TTO and patent counsel. Throughout the past 4 years of working together, we have realized success in bringing in additional research dollars from government agencies and industry and more traction in licensing engagements. In addition, we have been able to highlight and prioritize technologies at the university, allowing our efforts to be focused on the most marketable and useful technologies. We have also seen increased participation from faculty and their willingness to engage with FST as an agent acting on their behalf, based on their enhanced understanding of the commercialization process. Ultimately, the TTO is better positioned to determine the preferred commercialization pathway, including the release of IP to the creators or to the public, by being supplied with the marketing information provided by FST. In summary, we've created a model that enhances efficiency for prioritizing disclosures, outlining a commercialization path and developing milestones for success, in order to determine and define future efforts that are needed to move forward. These efforts definitely assist in reducing costs and time to market, thus resulting in an improved efficiency and effectiveness of small TTOs.

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The Role Of The Professional Technology Broker

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Abstract

The Technology Broker, whether active in the public or private sectors, is an essential figure in the Technology Transfer world, yet there remains limited formal recognition of the role and of the professional skills necessary to perform it well. Despite some advances (for example the work of the Consortium CERT-TTT-M there is still a lack of formal recognition of the Technology Broker and in particular of the need for professional standards in this field.

Starting from the result of CERT-TTT project, we apply our own approach to the definition of the three education levels, Basic, Advanced and Expert, to include recognition of on the job training and hands-on experience gained in the field.

In this way we develop a framework to recognize the professionalism of technology brokers also in terms of the training on the job which we regard as a fundamental part of the learning experience for technology brokers.

The framework takes account of core competences necessary to perform the role of technology broker, not just in a technology push sense but also in a branch-based, demand led context and draws on real experiences from members of the association. It is our intention to use this platform to achieve national and international agreement on professional standards for the profession of Technology Broker.

Keywords

Technology Broker, education, AIBT, AREA Science Park, CERT-TTT-M project.

1 Background

The Knowledge transfer process has been defined by the UK Research Council in 2006 (RCUK, 2006) as “the two-ways transfer of ideas, research results, expertise or skills between one party and another that enables the creation of new knowledge” and its use in:

- › the development of innovative new products, process and/or services
- › the development and implementing of public policy”

This definition is represented in the following scheme proposed by (Lockett and Robinson, 2008):

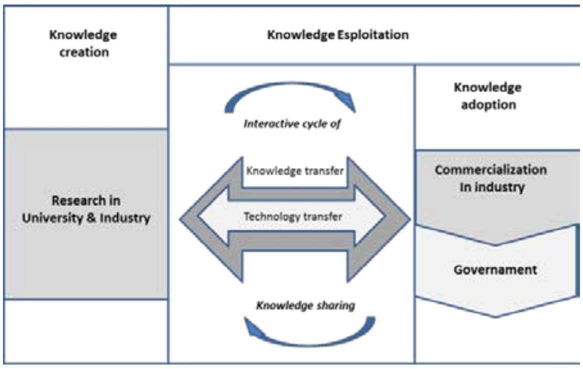

Figure 1: Definition of knowledge transfer in the context of Higher Education Institutions - HEIs

Innovation and knowledge transfer have been identified as essential ingredients of competitive advantage which drives increasingly knowledge driven economies (Lockett and Robinson, 2008). According to (Senge, 1990), Innovation is an idea, which can stimulate knowledge creation through knowledge exchange in order to facilitate "learning and unlearning" within an innovation system.

Lambert (Lambert, 1990) highlighted that "the best form of knowledge transfer comes when a talented researcher moves out of the university and into the business, or vice versa….Encouraging academics and business people to spend more time together should be a priority".

Some of the perceived barriers to a successful knowledge transfer within the university, that have been pointed out by Lockett and Robinson, are:

- lack of time and different perception of time scales
- the bias of incentives within university towards publishing research and teaching at the perceived lack of recognition of "third mission" (the first two are teaching and research) activities and IPR issue vs. publication
- the perception, by academics, of "problems" in the SME sector as not generating cutting edge research and the perception by industry (particularly SMEs) of the university as an "ivory tower", of academics being detached from the real world.

According to the Open Innovation Model developed by (Chesbrough, 2003), it is necessary to create a favourable environment able to valorise the knowledge transfer.

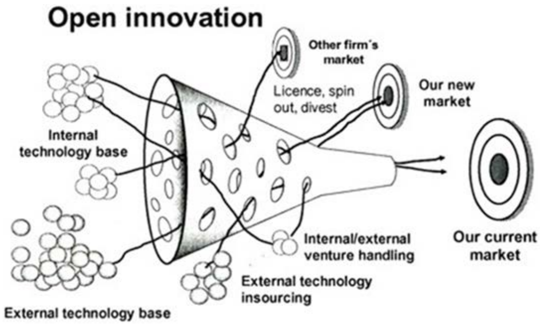

Figure. 2: The open innovation funnel

Following the previous statements, technology brokers are the actors able to establish the necessary conditions to favour knowledge and technology transfer between knowledge creators and knowledge adopters.

The Technology Broker, whether active in the public or private sectors, is an essential figure in the Technology Transfer world; however this role is still poorly formally recognized, as are the skills necessary to perform it well.

2 The state of the art

Still nowadays, the formal role of technology brokers is not very well defined. The project “Certified Trans-national TT Manager - CERT-TTT-M” founded within the 6 FP programme of the European Union (www.ttt-manager.eu), moved from the following reflections:

› lack of technology transfer - TT skilled people
› no TT education/training programme recognized all over Europe
› no registered TT profession

In order to fill the gap of TT skilled people, the CERT-TTT-M project developed a model for the setting up of a curriculum for the technology transfer professional. The framework developed addressed seven skills areas:

› Managing Communication, Information and networking
› Understanding IPR & Licensing
› Commercial Activities and Markets
› New business development
› Negotiating
› Project management
› Information analysis

“In the curriculum, three levels of education are distinguished”: a basic level, an advanced level and an expert level. “The curriculum is constructed in a way that candidates are able to follow a course of 2 days to develop a specific skill on a certain level”. …”A candidate can be awarded the professional tittle …if he/she has mastered all the different elements of the relevant level” (CERT-TTT, 2008).

On the top of the CERT-TTT-M project the European Knowledge Transfer Society – EuKTS project was established. EuKTS (www.eukts.eu) is funded under FP7 RTD OMC-NET (Support of the Coherent Development of Policies). It seeks to provide the necessary framework and infrastructure to support the development of the KT profession by:

- accreditation of course providers
- certification of professionals
- availability of comprehensive data on KT activity

The Consortium EuKTS includes existing KT associations (ProTon, IKT and LES), policy bodies and providers with experience of certification, accreditation and delivery of courses for KT professionals.

EuKTS proposes 3 professional titles based on different professional experience levels:

- Associate has 0-3 years of experience
- Professional has minimum 3-5 years of experience
- Expert is the highest level, with minimum 10 years of experience

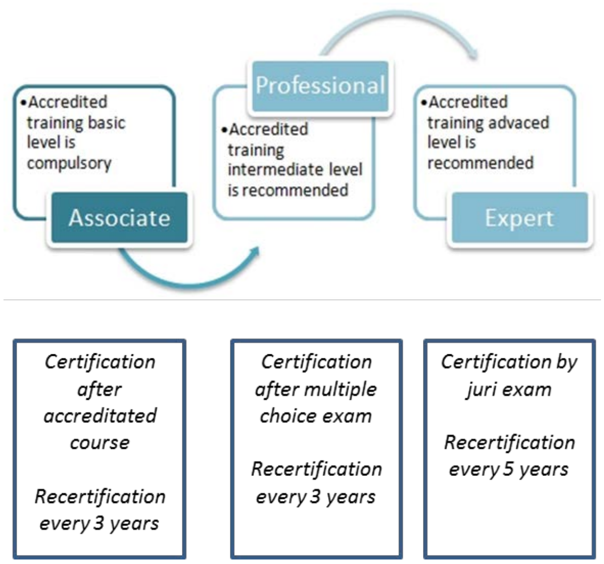

Figure. 3: the EuKTS certification process

The CERT-TTT-M project found that the gap of registered TT profession and lack of professional recognition can be solved following 3 different pathways:

- Self-regulation,
- Mutual Recognition,
- Automatic Recognition.

The CERT-TTT-M group suggested that the self regulation pathway can be considered as the best way to enhance the definition of a TT Professional profile rapidly and as a bottom up approach in which professionals of a certain field come together with the general aim to support the development of a profession.

Some other relevant experience in competence certification came from the Alliance of Technology Transfer Professionals (ATTP) that developed three parallel routes by which an individual can apply for Registered Technology Transfer Professional (RTTP) status. These three routes recognize the different ways in which an individual may have gained the knowledge and experience necessary to be a successful technology transfer professional (www.attp.info). ATTP was established to recognize and promote individuals with these core competencies and to provide approved training for individuals wishing to acquire these skills and become Registered Technology Transfer Professionals (RTTP). Linked to ATTP is the Association of European Science & Technology Transfer Professional -ASTP. The majority of its members are technology transfer professionals at public knowledge institutions. ASTP also has a plan to increase the knowledge level of technology transfer professionals via training courses.

3 A new training approach

The Italian Association of Technology Brokers - AIBT experience confirms the self-regulation pathway is the most efficient at the moment. AIBT was born in April 2009 by initiative of 7 professionals and 1 public organization, "Consorzio per l'Area Scientifica e Tecnologica di Trieste" (AREA) working in the field of technology transfer (AIBT, 2009).

AIBT is the first Italian association that involves professionals coming from the private and public sectors. Since the beginning, AIBT fixed criteria in order to ensure competence of its associates and it fixed professional levels and assessment modalities as professional requirements for the new members.

As association of brokers AIBT puts just 2 conditions to become member:

- a minimum experience in the field of 2 years and /or
- to be graduated in one of the technology transfer courses developed by AREA (Innovation Campus) or accredited by the Association.

AIBT opened the membership also to private and public/government organizations dealing with activities in the field of technology transfer and the role of the technology broker. Because, it was persuaded that the best way to develop a class of professionals came from the sharing of experience by organizations and single individuals working in different and complementary contexts.

Having been the first Science and Technology Park to be established in Italy AREA was well positioned to drive the development of Technology Transfer activity and subsequently the role of the professional Technology Broker.

The training that will be described below, is based on the experience gained, in the years following the foundation of the technology transfer department in AREA, when excellent results were achieved, thanks to the professional staff who have contributed their efforts. In fact the "Innovation Network" the technology broker programme Area operates in Friuli Venezia Giulia and the "Sister" programme for the valorisation of research have achieved the following results:

INNOVATION PROJECTS WITH INDUSTRY	
Companies involved	3546
Innovation projects completed	2363
Patents deposited by companies	121
Revenue increase attributed to the innovation project	+ 7 %
Increase in workforce attributed to the innovation project	+ 5,25%

Table. 1: AREA's innovation projects with industry

VALORISATION OF RESEARCH RESULTS	
Research groups interviewed	349
Research results identified	336
Valorisation projects	684
Patents deposited by researchers	79
Research-industry collaboration agreements	40
Spin-offs	23

Table. 2: AREA's valorisation of research results

AREA had developed a series of methodologies for Technology Transfer which required a particular blend of skills whish were not easily found ready-made in candidates who presented themselves for interview, so the decision was taken to recruit candidates with a good scientific or technical education and fill in the "soft skills", such as interpersonal skills, interview and negotiation techniques, creative and lateral thinking etc. as well as the necessary knowledge of the local context, with tailor-made training programmes. These training programmes combine classroom-based training with the essential on the job training which completes the picture. Without this real-world on the job experience the training remains too theoretical and academic and insufficient to really claim to have provided the individual with all the skills necessary to take on the role of professional technology broker.

Having kick-started a series of initiatives to build bridges between the research community and the business world, AREA soon recognized the need for tailor-made training programmes for Technology Transfer Professionals. Thus was born Innovation Campus, an initiative to train Technology Brokers in the skill sets and methodologies used by AREA in their technology transfer activities.

Having successfully trained Technology Brokers for its own use AREA opened the training programmes up to other organisations and individuals and set up a collaboration with Politecnico di Milano so that the courses offered could be formally recognised as a Masters Qualification, MASTER in Innovation and Knowledge Transfer. The classroom-based training programme covers a wide range of subject matter as seen in the following extract which lists the major training modules and sub modules with the topics covered in the first edition of the master in Innovation and Knowledge Transfer (Master MIT):

MODULE 1: UNDERSTANDING THE CONTEXT (20 hours)

The research and innovation ecosystem - The systems key players: universities and technology transfer offices - The systems key players: science and technology parks, companies and industrial research centres -

The systems key players: public research organizations, scientific poles and technological districts -The systems key players: government agencies and ministries

MODULE 2: BASIC COMPETENCES (36 hours)

THE PUBLIC SECTOR RESEARCH SYSTEM: Science economics - Technology transfer models - The valorisation of research results: research projects, licensing, spin offs

THE INDUSTRIAL SYSTEM: Innovation economics - Collaborative innovation - Technology strategies and alliances (corporate R&D) - The marketing function – strategic and operational - Master in Innovation and Knowledge Transfer Master MIT

MODULE 3: TRASNSVERSE COMPETEN-CES (52 hours)

Intellectual Property: strategies, requirements, procedures and types of protection - Leadership and motivation - Negotiation techniques, conflict management and the psychology of the players involved - Project Management - Innovation management

MODULE 4: PROFESSIONAL OPERA-TIONAL COMPETENCES (56 hours)

FROM RESEARCH TO INDUSTRY: Licensing: procedures, activities, tools and case studies - The valorisation of patents, trademarks and intangibles – Spin off: set-up procedures and tools (statute, contracts, etc.)

SUMMER SCHOOL: FROM INDUSTRY TO RESEARCH

AREA's Technology Transfer model - Contact and connections with industry - Contact and connections with the research world: scouting for competences - Technology broker experiences

OPPORTUNITIES FOR INDUSTRY AND RESEARCH COLLABORATION: National and European finance opportunities - Learning assessment - Intermediate Project Work Presentation

MODULE 5: UNDERSTANDING THE CON-TEXT (16 hours)

Governance in the public and private sectors - Research policies - Industrial policy - Policies regarding university-industry collaboration and technology transfer

MODULE 6: ADVANCED COMPETENCES (40 hours)

THE PUBLIC SECTOR RESEARCH SYSTEM: Patent research, strategies, procedures and tools - Types of collaborative research and IP management - Fiscal and taxation issues regarding research projects and contracts - Dispute resolution: strategies, procedures and calculating damages.

THE INDUSTRIAL SYSTEM: Strategy - Design driven innovation - IP management in industry

MODULE 7: ADVANCED TRANSVERSE COMPETENCES (36 hours)

Organisation - Balance Sheet and Audited accounts - Management accounting and internal controls - BPR and process management - Evaluating investments (and financing start-ups)

MODULE 8: ADVANCED PROFESSIONAL COMPETENCES (56 hours)

FROM INDUSTRY TO RESEARCH: Business plan: drafting and evaluating - Market research and marketing for internationalisation - The role of venture capital and business angels, how to finance start-ups and spin-offs - Learning assessment

SUMMER SCHOOL: FROM RESEARCH TO INDUSTRY

International technology transfer models and examples: MIT and SIR International - Organisation of a technology transfer centre - Organisation of a technology transfer centre: Case Study Ohio - Communications and research: intangible assets and Dynamic Activity Profile - Managing complexity - Business Intelligence methods (analysis of business opportunities from research to market)

OPPORTUNITIES FOR INDUSTRY AND RESEARCH COLLABORATION: Managing European Finance opportunities, consortium agreement and IP - Final Presentation of Project work

In addition to the classroom-based training the technology brokers of AREA also underwent intensive on the job training, an essential ingredient in their professional development, which typically lasts six months and includes a range of activities reflecting all of the theoretical aspects covered in the formal course in a hands-on way.

4 The training results in new contexts

Having consolidated this experience AREA went on to develop a major initiative in Basilicata another region of Italy, to set up, from scratch, a Technology Transfer capability. AREA, through its in-house company Innovation Factory, recruited and trained 30 young people in Basilicata using the training programmes illustrated before and contextualised for Basilicata. Following a period of classroom-based lessons a long period of on the job training led to the high quality of the professional technology brokers in Basilicata Innovazione who have achieved remarkable results:

INNOVATION PROJECTS WITH INDUSTRY	
Companies involved	804
Innovation projects completed	384
Patents deposited by companies	6
Revenue increase attributed to the innovation project	+ 8,1%
Increase in workforce attributed to the innovation project	+ 7,3%

VALORIZATION OF RESEARCH RESULTS	
Research groups interviewed	131
Research results identified	16
Valorisation projects	44
Patents deposited by researchers	1

Not content to sit back and bask in the glory of this achievement AREA set out to do even better in an even more ambitious project in Calabria another Italian region. Working with a local partner, Fincalabra, AREA began an intense training programme to train technology brokers to operate across the Calabria region. Local Project Managers were hired to manage each key function and were intensively trained and continuously supported from the outset by experienced Project Managers from AREA headquarter in Trieste (Italy). A larger number of brokers was then recruited and trained with the combined supervision of the local Project Managers and their more seasoned Technology Transfer colleagues from Trieste.

5 Conclusions

On the top of the experience based on the know-how of AIBT member's like AREA's technology brokers, a technology broker must have a solid technical background as this is one of the major assets if not a pre-requisite. A good education is important but experience of industry is also very valuable.

Soft skills can be taught but there are definitely people who have a greater or lesser predisposition to certain activities, A good professional Technology Broker requires a mix of skills that is very rare. This mix of skills can be summarised in:

- Solid education background: technical – economic, managerial skills.
- Soft skills: proactivity, empathy, problem solving, listening ability and skill in finding new and innovative/alternative solutions and pathways.
- Experience in the field: a good working experience in companies. Companies especially dynamic SMEs can be considered as a gymnasium in which the TT professional has to face every day a wide range of new challenges.

In terms of training the experience of AIBT's members is that this mix can be created but that in order to create it rapidly it is essential to recruit very selectively to have as many as possible of the basic skills already present and then to use a mix of training approaches to rapidly bring potential Technology Brokers up the learning curve.

The technology broker as suggested by Lockett and Robinson is the intermediary, the translator, the trust and bridge builder between 2 blocks:

- research in university and industry
- company and government.

He is the interpreter of the needs and interest of these 2 different blocks. The technology broker in the framework of the current economic crises is the missing stakeholder at the planning table.

A strong framework of competence and soft skills are necessary to give to the technology broker the necessary authority to lead us out of the current crisis and to contribute to building a brighter future through the effective application of technology transfer to drive innovation and economic growth.

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Research Commercialization In Finnish Universities Of Applied Sciences

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Abstract

The Universities of Applied Sciences (UAS) in Finland have lately focused on research commercialization. Tekes – the Finnish Funding Agency for Technology and Innovation - funded UAS research commercialization in Finland during years 2008 to 2012. During the program UAS sector filed over 1700 research commercialization ideas. The paper introduces the Finnish UAS methods for research commercialization, its theoretical base and practical process as well as experiences. The paper studies the process from activation to evaluation and business model development in selected cases. Comparisons to university sector in Finland will be made. The practical part is based on Western Finland UAS consortium's experiences on research commercialization. The paper explores both quantitative and qualitative results. It studies how commercialization actions can be integrated as a systemic model that fits to the teaching and learning processes of UAS. Future research suggestions are also given.

Keywords

Commercialization, research knowledge, innovation.

1 Introduction

During the time period of this research Tekes funded 1839 cases in the University sector and 875 cases in the UAS sector. Universities were funded in three phases and UAS sector in two phases. Universities created 135 start-ups and UAS sector created 52 start-ups. For Universities this means about 7% of funded cases ending up as start-ups and in UAS sector about 6%.

UAS sector is in the beginning of their commercialization process development with a few years of history. Therefore it is important to study the development, promising practices, and their integration to the UAS system. It is important to share the experiences, bring them to open discussion and identify future opportunities and further research areas.

Innovation is about novelty and benefits (Kettunen et al. 2008). Innovation can be defined as a new commercial product or service. Innovation management aims to the management of the innovation process. Earlier, the management of innovation was the management of a new product or service process. At present it also includes the management of people, resources, funding, networks, strategy and learning. (Tidd et al. 2005, Apilo et al. 2007, Laine 2010).

Innovation management refers to management of strategy, process and networks of new ideas and their utilisation. There are several types of innovations and they require diverse processes and networks. To manage innovations it is also important to notice the separate phases of the innovation process. Systemic approach requires that the innovation process should be managed as an entity. It is not enough to optimise one part of the innovation process. Most of the innovations are created in intra-organisational networks. Therefore the third important part of innovation management is to understand how networks can be utilised in the creation of innovations. (Tidd et al. 2005) Effective innovation management is not doing single phases definitely well, but the capability to manage all dimensions of the innovation system (Rothwell 1992). Good innovators emphasise a *systemic approach* to the innovation process which is not only maintained but also continuously developed (Bessant et al. 2005).

In general, *a process* is a set of activities that produces value. The nature of innovation is fuzzy and nonlinear. All activities do not have clear beginnings and ends. Therefore it is difficult to describe *an innovation process* as linear processes supporting it. (Kettunen et al. 2008, 10). An innovation process is difficult to model in an accurate and repeatable manner but it can be modelled as a general process (Tidd et al. 2005, 67-69, Tidd and Bessant 2009, 54-55), which consists of searching, selection and implementation. These phases are linked to strategy and organisation. The innovation process cannot be separated from other functions of the organisation or from its environment. (Tidd and Bessant 2009, Tidd et al. 2005, Tidd 2008).

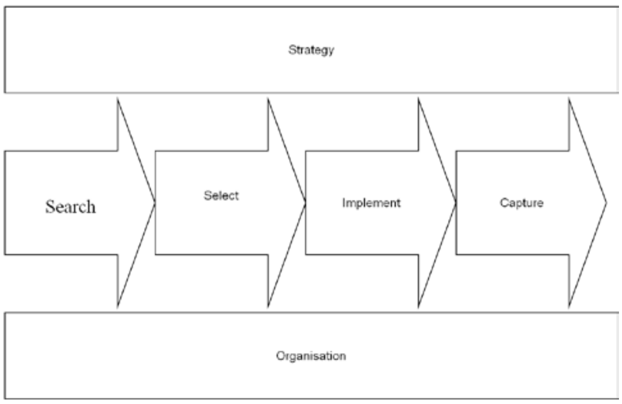

Figure 1. General model of an innovation process

The first paragraph describes the modelled commercialization process. It concentrates in the beginning of the process. In the second paragraph an incubator process for students is described in order to show how these processes can be integrated into learning processes. In the third paragraph two examples of developed innovations are described to show further types of integration into the learning processes. The main results and findings are presented and discussed. Finally, some conclusions are drawn and future research suggestions made.

2 Commercialization process

In this paragraph the beginning of the innovation commercialization process is described. The described model is based on several years of piloting in the Western Finland UAS consortium.

The aim of the consortium was to integrate the commercialization process to the learning processes of the university. The key issue in the integration is to define small development steps for the commercialization process and to combine them into teaching and learning processes. The aim is to connect students, teachers and researchers to development steps. Multi-field teams are started for development in all cases. During the piloting the process is modelled and developed in collaboration between the members of the consortium. The phases of the process are the following:

Phase 1. Activation. In this model the idea owners are either students or personnel of the UAS. Several types of information sharing and activities are used simultaneously. Constant actions are needed to add awareness to commercialization. The actions can be

- Marketing materials
- Campaigns
- Innovation contests
- Innovation fairs
- Web pages
- Intranet pages
- Face-to-face meetings
- Events in students programs and for teachers and researchers
- A Walking Coffee Trolley
- Peer-groups, like Business Club
- Spring Events and Case Cocktails

A Walking Coffee Trolley (figure 2) is an effective method to meet researchers and teachers face-to-face. It is easy to share information about commercialization and technology transfer services in the university when you meet people and you can easily discuss with them. The Walking Coffee Trolley is also a great possibility to harvest early-stage ideas and expertise. Other effective activation methods are two different workshops called Idea Coffee and Business Club. The Idea Coffee is a sort of learning coffee with different cross sectorial themes. Typically an inventor or an entrepreneur gives an introduction for the discussion. The Business Club is a peer-group for researchers and teachers interested in research commercialization. It provides a chance to share knowledge within the community of university staff. In addition to this there are Spring Events and Case Cocktails. Typically these kinds of events include e.g. recognitions, awards and telling the stories, which raises awareness of innovations on a general level.

Figure 2. A Walking Coffee Idea Trolley

JAMK UAS also measures an impact of these activation methods by phone call surveys. Annually 200 staff members are chosen randomly to answer several questions. The results from these surveys are shown in Figure 3 and 4.

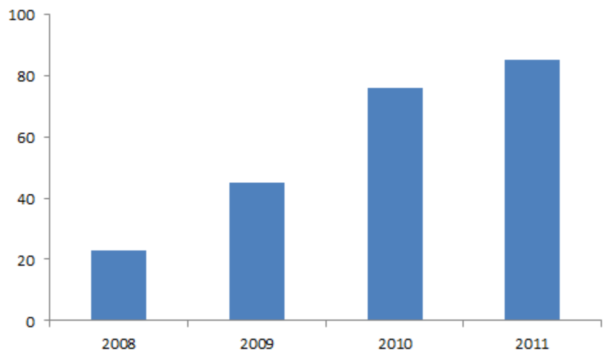

Figure 3. Percentage of staff member knows aware of innovation support services at the university.

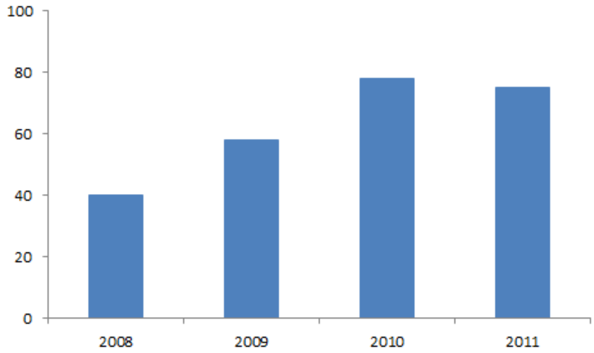

Figure 4. Percentage of staff member aware of what could be commercialized.

The activation phase, described above, is an important part of the whole process because it ensures a sufficient idea flow.

Phase 2. Collection of ideas. Idea collection is done with traditional paper forms, web pages, or database platforms created for this purpose. Database platforms make the process faster because all ideas can be seen online by the authorized users of the system. This also makes iterations faster if further information is needed. Web-based systems can also lower the threshold of sharing ideas because the systems are easy to access. Ideas can be added as incomplete, to be further worked afterwards by the idea owner.

Ideas are collected in many ways. The amount of ideas collected with different methods in Tampere UAS can be seen in Figure 5.

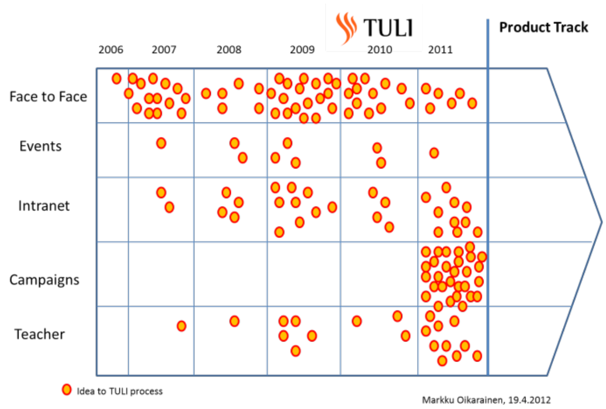

Figure 5. Ideas collected with different methods in Tampere UAS

Ideas cover many fields of industry in all universities. In Tampere UAS they are ICT and electronics (16%), software and digital media (12%), forest and chemistry (7%), metal products (8%), real estate and building (11%), energy and environment (12%), services and well fare (18%), bio, medical, and food production (7%), and others (9%). This emphasises the multi-disciplinarity of the scientific teams in the evaluation development in order to ensure equal processing of the cases.

Phase 3. Pre-evaluation. The phase is carried out by the owner of the idea with the support of an innovation specialist. Additional documentation and knowledge searches are made if needed. The current state of the idea is declared and documented. NABC model (Carlson and Wilmot, 2006) is used in this phase. Background information is gathered according to documentation models. A contract with the idea owner is written so that UAS can act in the process and have access to the information involved in the process.

Phase 4. Evaluation. The pre-evaluation information gives the first ideas of commercialization opportunities. The Innovation team discusses the idea and further actions are decided on. Experts connected to the case have their networks they can utilise. Bachelor Thesis projects and undergraduate student projects can be utilized, too. Teachers' role is to see that learning is supported and credit points earned if the idea owner is a student. Additional actions can be taken by UAS if needed. There are several structures and processes supporting this phase like Entrepreneurship Campus (Tampere UAS) and Enterprise Accelerator, Apparatus, Soteekki, and Living Lab environments like Innovation Learning Lab (Satakunta UAS). In these learning environments small development steps can be taken with low costs.

At the evaluation phases JAMK evaluation board judges ideas, makes "go/no go" -decisions between the different phases, grants the funding for external analyses by consultants, etc. JAMK evaluation board includes staff members with different competences. Typical operations or "tools" during the process are

› R&D projects with internal or external funding for analysing and testing the feasibility, for product or service development and design, proof of concept

› Internal financial support for product development

› Student projects as processes or tools for the development, project courses, Innovation month, etc.

› External TULI and Product Track funding subdivided by JAMK Evaluation board for external analyses by consultants: mainly market and IPR -analysis for different phases

› JAMK capital funding for start-ups

› Counselling, business, juridical etc. areas.

The innovation support process with different phases shown in Figure 6 was developed during the TULI –projects 2008-2012.

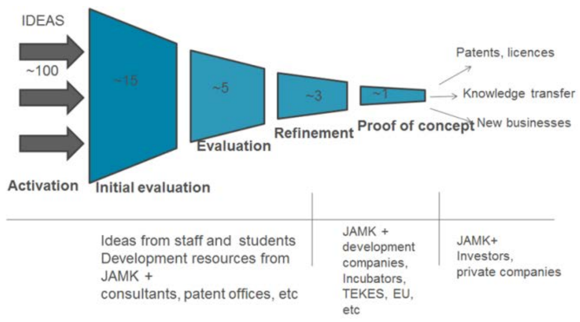

Figure 6. The innovation process of JAMK UAS.

Networks for commercialization are personal, local, national and international. Network partners can be universities, research institutions, technology development companies, consultants. It is important to keep the process as agile and open as possible; although IPR issues hinder all open process. Justified sharing of benefits is important in keeping all shareholders interested.

An agreement for parallel access rights can be made with the owner of the idea. Usually ideas proceed faster when the owner of the idea is involved in the development process (Oikarainen 2013). NDA agreements are written by participants. In thesis works confidential parts of the development are separated and not published with the thesis. This requires extra work from the mentors involved.

The focusing of the idea is done using the NABC model. NABC model is based on four views: needs, approach, benefits and competition. These four angles must be solved sooner or later in the commercialization process. Therefore it is used in the beginning of the process to avoid mistakes and to save time in the forthcoming phases of the process. The NABC can be followed by more detailed market analysis made by external experts. Simultaneously IPR issues are analysed as soon as possible. These are the basis for a preliminary business plan. Demonstrations, modelling or mini prototyping (3D printing for example) may be needed to ensure the functionality of the solutions created. Additional analysis and research is done if needed. All actions are as parallel as possible. On the other hand, in every phase only the essential action is taken. This is to save time and to utilise the recognized opportunity window. Parallel processing on actions of Case Metrirunko® are seen in Figure 7.

Figure 7. Parallel actions of case Metrirunko® in Tampere UAS

Shared case database, reports, and the follow up process ensure that there will be a continuous development chain regardless of breaks in funding. Metrics is based on own indicators and funding organization's indicators.

The organization of actions is based on regional, consortium, and national collaboration. In UAS there is typically one person responsible for the collection of the ideas and an innovation team of typically 4 to 10 people. Then there is a local Product Track innovation team. The Product Track also has a national network for actors.

Phase 5. Optional extension into next funding state. Most promising cases and those that fit the national Product Track process are transferred to this process where the cases can have more funding and support for commercialization.

The innovation process is integrated in several ways to the education process of UAS. It requires several tools, processes and funding to be used. Teachers have new roles in the activation and in integrating the innovation process into teaching and learning processes. This requires a new allocation of resources of the university and additional flexibility in learning processes.

3 Incubator for student entrepreneurs

Some ideas turn into new enterprises. Therefore it is important to integrate an incubator into a higher education institution as well. This paragraph introduces an integrated solution for applying a student incubator in higher education.

The Enterprise Accelerator of Satakunta University of Applied Sciences is an innovative pedagogical combination of research and development and higher education. It gives students the opportunity to become entrepreneurs already during their studies. Another option is to join in the accelerator activities with an already existing enterprise. The Enterprise Accelerator operates within all degree programs at Satakunta University of Applied Sciences. It helps students to become entrepreneurs before their graduation.

The Enterprise Accelerator helps students who have a business idea or an operating company. They will also be assisted in enterprise succession or acquisition of an enterprise. A cooperation agreement and an individual study plan in entrepreneurship will be prepared for each student in the Enterprise Accelerator. The student is supported by a mentor network. An expert mentor encourages and advises the student entrepreneur. The student can obtain as many as 60 ECTS credits for completed studies related to the setting up of and developing the enterprise. The Enterprise Accelerator process with follow up is described in Figure 8.

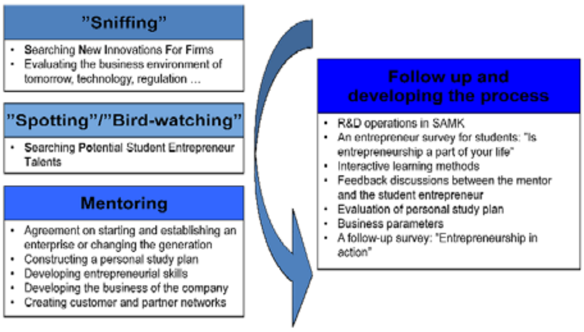

Figure 8. Incubator Process of Enterprise Accelerator in Satakunta UAS (Kainu et al. 2010)

Enterprise Accelerator offers mentoring services to all students. The mentor's role doesn't end even when the business is set up and running smooth. Mentoring is based on a mutual agreement and a written contract. After graduation there is an option to change the mentoring relationship to an innovation partnership between UAS and the entrepreneur. The partnership aims for new innovations based on collaboration.

The Enterprise Accelerator has served student entrepreneurs in Satakunta University of Applied Sciences since 1997, with over 250 student enterprises from various disciplines. Nowadays nearly two new enterprises are launched every month. The Finnish Ministry of Education has awarded the Enterprise Accelerator of Satakunta University of Applied Sciences as a Centre of Excellence in Education.

Satakunta UAS runs an EU funded project called 'Innokomppi' together with Jyväskylä, Turku, Laurea, and Rovaniemi University of Applied Sciences. The aim of the project is to find the key innovation competencies and to build the metrics to evaluate these competencies, and finally develop ways to measure competence progression of students. Typically, learning environments in higher education do not support enough development of innovation competencies to lead into increased student entrepreneurship activity. The project produces new methods and tools to validate pedagogic solutions for developing innovation readiness in higher education. This leads to new opportunities of combining innovation processes and learning and to creating innovative business ideas and enterprises in the future.

It is possible to integrate incubator and innovation competence development with higher education. However, the learning environments and pedagogical approaches are to be under constant development. This is to ensure that UAS can respond to changing needs of innovation and entrepreneurship.

4 Invention based business development

Innovations can be used, in addition to pursuing economic benefits, as learning objectives and learning environments in many ways (Lehtonen and Räsänen 2012). There are several patented inventions used for learning purposes in Turku University of Applied

Sciences (TUAS): (i) related to the patented Timperi frame system, an edge-glued laminated timber beam has been researched in cooperation with students since 2010; (ii) the C pile is a patented new way of making drilled micropiles and retaining walls; (iii) sealing sheet pile structures with cement is a patented invention for watertight underground walls and the damping of soil vibration; (iv) industry based invention for the use of steel mesh as soil reinforcement and (v) the nutrition catcher is a patented method to reduce soil particles in flow-waters, e.g. ditches. In addition, the annual competition on innovative student projects "ICT Showroom" has provided a learning environment to hundreds of students since 2008 (Roslöf et al 2011).

The Timperi timber frame system is a production technology of prefabricated houses created at TUAS. The students have participated in the design and construction of the houses as assistants. TUAS has purchased a site from the city of Turku for the construction of two detached houses, of which the construction began in 2009. The degree programme has carried out the construction design, structural design and element design for both sites. The timber construction inventions have been a learning environment for many years contributing credits for students. The main part of the credits is thesis based (Fig. 1), but the students have got credits on working in projects and exercises, too.

The C pile is a patented new way of making a so-called drilled pile. Unlike former steel piles, C drilling is utilised in an open C profile and installed into the ground with a new kind of an eccentric drill. Developing the method sets challenges for the development of both pile material and pile driving equipment. The C pile is developed in cooperation with Emeca Oy and Robit Rocktools Ltd. As a learning environment, the development of the C pile has produced half a dozen theses and several project works. When foreign exchange students have participated in research hatcheries at TUAS, they have been given a learning task related to the invention. A typical example of these learning tasks might be to find possibilities for the use of the invention in their home country. In the future, the development of the C pile could be continued in, for example, sales teaching or student cooperatives.

Sealing sheet pile walls with cement is a new patented invention made by a teacher and a student from the Degree Programme of Civil Engineering. By applying this method, it is possible to construct a completely watertight underground sheet pile wall. Such a structure could be used, for example, when constructing an underground car park.

Steel mesh can be utilised in road construction in various ways. With steel mesh reinforcements, the bearing capacity of soil can be improved, dents repaired and frost heave cracks prevented. At TUAS, several Bachelor's theses in engineering and one Master's thesis in engineering have been completed on the subject. Steel mesh has been studied and developed for several years in close cooperation between Tammet Oy and TUAS. The company has developed the method from the point of view of technical production and applied for several patents in connection to the technology. The students in Civil

Engineering have received the latest innovations as learning environments as soon as they have been made public.

The nutrient catcher can be used to "catch" sediments and thus nutrients from water. Catchers will be suited for specific situations, such as water construction during times when water can contain high amounts of sediment and solute nutrients. Catchers will be suited for small streams and they are expected to assist in containing non-point nutrient loads from e.g. agriculture. Also the sediment loads from forest draining and peat production can be affected with the catcher.

The business development of inventions can be supported by new financing instruments introduced recently by Foundation for Finnish Inventions (Foundation for Finnish Inventions 2013).

The inventions have been an interesting learning environment for Finnish students and, in addition, for many exchange students who have mapped the possibilities for potential business of respective inventions.

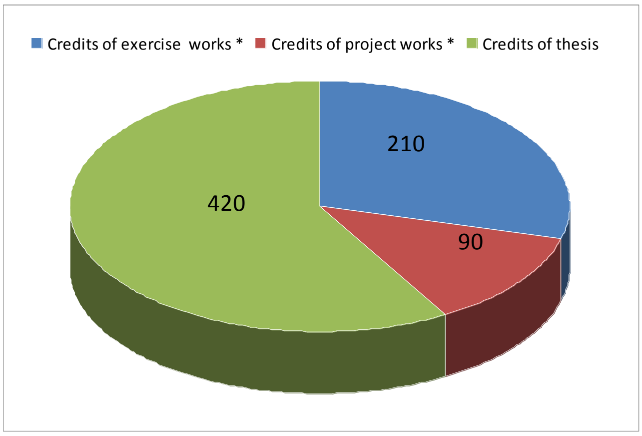

Figure 9. The Timperi technology based study credits in the Degree Programme of Civil Engineering. The thesis credits include the number of credits from two Master's Theses and a Doctoral dissertation among the degree programme personnel.

Exchange students have attended several R&D and innovation projects working with and studying topics as follows:

(i) micropile applications and market surveys in Brazil, Portugal, France, Germany, Italy, Spain

(ii) sheet pile wall market potential in Germany, France, Portugal and Brazil

(iii) wood structure applications (a German student).

Business impact based on innovation activities at TUAS has been relatively limited until now due to the early phases of the innovation processes. Several patents owned by TUAS have been licensed to industry and respective business has started typically as pilot cases. On the other hand, steel mesh applications business has grown substantially as the original invention was first introduced many years ago already.

5 Main results and findings

Based on these results it can be seen that the awareness of innovation and commercialization possibilities has increased during the activation. The teacher's role is important in knowledge transfer to students. It is also evident that the number of ideas has increased remarkably from 2008 to 2011. However, there seems to be a time delay, at least of 1 or 2 years, between the start of the activation and the first innovations. This observation should be taken into account when the organization develops e.g. a new innovation process.

NABC model (or similar approach depending on the UAS) was used from the very beginning of the process to ensure that the most important views are covered. Time is not wasted or lost in the process. Small development steps, fast parallel processing within the development, and multi-field teams were needed to ensure agility and to lower risk in the development. Threshold to sharing ideas should be low and the process should be progressive, value adding, and selective. Based on the research it was not possible to build a single systemic process model.

Pre-evaluation and evaluation phases worked well. Collaboration within the consortium was good in this area, but in other parts of the process and in systemic approach the actors can learn a lot from each other, because the strengths are in different fields. This is due to the fact that most of the collaboration considered the evaluation of the cases.

From the beginning it was clear that in addition to a more effective activation, more capacity in the process was also needed. There was also a need for additional added value in the process. The model and process was tested several years with TULI funding. Ideas were turned into concepts and innovations. Processes were modelled and improved. Ideas were born in many ways and many places, so it was important to use a systemic approach and many channels to capture as many ideas as possible.

Student based ideas turned into innovations faster than teacher and researcher based ideas. This suggests that processes should be different for students, researchers and teachers. The funding introduced in this paper did not cover all UAS commercialization activity. It covered the beginning of the commercialization process with funding limitations. All start-ups did not start within the funded processes. Satakunta UAS has 250 student based start-ups since 1996, most of them without financial support entrepreneurs. Ideas came from all faculties, but there were only few ideas from faculties of business. No clear reason for this was found. In the end of the process the focus was on students' ideas. The results would have been better if the students had been in the focus from the beginning. The process should be easy to access and progressive and value adding.

Innovations were utilised in learning and learning environments in many ways. Strategy connection needed focus and resource allocations. The next steps are international start-ups and growth firms. Compared to the university sector, UAS sector is perhaps one step behind but learning fast and exploits its strong connection to learning processes. Not all opportunities have been explored. There are ideas that have not been captured by the system yet. The systemic approach also creates opportunities that are not yet utilized.

Concrete results are only one part of the outcome. The developed processes and culture are even more important for the future. Some UAS (for example Jyväskylä UAS) have their own Innovation fund to fund innovations perceived as important from UAS perspective. Some UAS have defined an innovation policy in their strategy documents. However, these processes, cultures, policies, strategies and cultures vary in UAS sector. It looks like every UAS is seeking for an optimal mix of tools, processes and policies according to their commercialization goals. All this requires a strategic focus, resources, and a long-term commitment from the organizations involved. Because of the systemic nature of commercialization it is difficult to separate it clearly from all other actions and costs of organizations.

In the final report the funder noticed that UAS sector made significant improvements in their commercialization process. Both the commercialization process and the services related to it were improved. Networks and shareholder interaction related to commercialization improved as well. Awareness of teachers, researchers, and students was added. In a way this is good because innovative solutions are created. At the same time similar tools, processes and methods are created in several places. The Western Finland consortium could benefit from learning from others' successes and mistakes as well.

Start-ups were born national, not international. In the future the focus will be more on international and growth seeking start-ups. In this, UAS sector can benefit from their international contacts and personal networks. Some UAS have already moved to this direction. UAS sector increased its own funding for commercialization during the piloting.

Multi-field innovation teams were considered important especially when seeking for external funding. Collaboration was arranged with regional and consortium actors. In the future internalization must happen with the best partners in the field.

Members also shared expert connections, although the expert pool was not growing fast enough. Finding the right kind of expertise for cases was sometimes difficult. The consortium was active and knowledge and experiences were shared openly. Cases were discussed together and all actors could learn from others' cases and processes. Collaboration between the members of consortium accelerated learning and helped develop the cases in practice. Meetings were effective and flexible. Video meetings made it possible to have meetings regularly. A shared database helped sharing data, case reports, agreements, modes etc. The collaboration itself was not funded. This was seen as a negative factor that hindered the development.

6 Conclusions and recommendations

Support is needed in the beginning of the commercialization process. Service providers need to network as well. Several types of actions can be used in activation. It is crucial that the idea owner herself uses an analytic approach and identifies whether it is reasonable to proceed in the commercialization process or not. IPR rights are not a goal but they may support the commercialization. In the idea development a multi-disciplinary or scientific team adds agility and adds competence response to changes in knowledge, environment, and markets. The end customer needs must be the main guiding principle for the goal oriented development steps. There is space for new ideas in the intersections of knowledge and technology areas. Ideas are not to be killed by owning them by the university. Justified sharing of benefits is crucial for keeping the commercialisation process alive. The University must allocate its own resources to support the commercialization process. This is especially true in the integrated model described in this paper. The approach also creates opportunities to enhance competence evaluation and measurement in education.

Research commercialisation requires systemic approach, not optimisation of single phases of the process. Based on this research it is not possible to build a single process model for commercialisation.

The comparison between UAS and university sector is not easy because they have different roles, development history and situation. However, it seems that about the same amount of ideas end up as start-ups on both sectors but it is difficult to compare the quality of cases. It is clear that both sectors have made improvements in their commercialization processes based on their strategic lines.

The results presented in this paper apply the UAS sector in Finland. The innovation process phase results apply more generally. These results apply to higher education institutions that want to integrate the commercialization process and innovation development processes to teaching and learning processes.

The next steps in the research are how to network more closely nationally and thematic in the development of innovations and how to build focused international networks in the described integrated model.

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What Differentiates Top Regions From Other Regions In The Field Of Biotechnology?

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Abstract
Over the last decade, research on the cluster phenomenon, especially in the field of biotechnology, provided valuable insights in the emergence and early development of regional biotech activities. So far, large-scale quantitative analyses studying the specific contribution of firms and knowledge institutes in regional technology development during the growth phase of biotech are however lacking. Building on patent and publication-based indicators, our analyses encompass the texture characteristics of 101 regions in North-America, Europe and Asia-Pacific that developed substantial technological activities in the field of biotechnology over the period 1992-1997. This period corresponds with the era of rapid growth in the biotech industry in which industrial capabilities are evidently becoming more important. Our findings provide evidence for the presence of two distinctive types of biotech clusters: “concentrated” clusters in which technology development is mainly situated within private firms and a dominant role is played by anchor tenant firms (established pharmaceutical firms in the region); and “distributed” clusters in which technology development is more equally distributed between private firms and public knowledge institutes and the entrepreneurial orientation of scientific actors plays an instrumental role. Using fixed effect logit regression models, we investigate which texture characteristics differentiate top regions from other biotech regions. Beside the continued importance of investing in a strong local science base (also after the early incubation phase of the technology) and the necessity of creating industrial activities in the field of biotechnology, our findings indicate that both types of regions (“concentrated” and “distributed”) also differ to some extent in terms of antecedents of growth. Top “concentrated” regions benefit from increased levels of concentration of technology development activities within the leading firm as well as from engaging in international technology collaborations with scientific actors. Top “distributed” regions benefit, along with an excellent science base, from a more entrepreneurial orientation of their knowledge institutes. The results of the paper therefore point to the relevance of policy measures tailored to the specific texture characteristics of regions in order for regions to develop into top regions during the growth phase of the industry.

Keywords
Biotechnology, (high tech) clusters, technology development, entrepreneurial universities, industry.

1 Introduction

Biotechnology is often considered as one of the promising technologies that can contribute to the economic growth and welfare of a region. At the same time, evidence indicates that only a limited number of regions have actually developed into successful biotech clusters (Audretsch & Feldman, 1996; Feldman & Florida, 1994). Thriving clusters such as the San Francisco Bay Area (‘Silicon Valley’), San Diego and Boston have therefore been widely studied by researchers and policy makers in order to identify the main factors behind the success of those biotech clusters. Consensus indicates that well developed biotech regions, so-called clusters or hot spots, are characterized by the presence of world-class scientific research, high levels of entrepreneurial activity (both academic spin-offs and industrial ventures), high labour mobility and dense social networks, and the presence of venture capital and a dedicated support infrastructure (e.g. Casper, 2007; Cooke, 2006; Owen-Smith, Riccabonni, Pammolli & Powell, 2002). About the respective role and importance of public knowledge institutes and private firms for the emergence and early development of biotech regions different perspectives are being advanced. Case study research provides evidence that universities and knowledge generating institutes have played a central and active role in the creation of biotech clusters in the region of Boston (Breznitz, O‘Shea, & Allen, 2008) and the San Francisco Bay area (Chiarone & Chiesa, 2006). In contrast, private firms have been advanced as playing a pivotal role in the development of biotech activities in the regions of Milano, Italy and Uppsala, Sweden (Chiarone & Chiesa, 2006) as well as in Japan (Bartholomew, 1997).

While these qualitative, case-oriented, studies provided valuable insights on the characteristics and the dynamics within single (biotech) clusters, so far large-scale empirical studies addressing the texture characteristics of biotech regions in a quantitative way, are absent. As (industrial) biotechnology is clearly entering a growth phase (Lecocq & Van Looy, 2009), the question whether regions can evolve into leading clusters by relying on a distributed texture or whether the presence and/or emergence of an anchor tenant firm is a prerequisite in this respect becomes a pertinent question, both for practitioners and policy makers engaged in regional economic development.

Building on patent and publication-based indicators, we engage in such a study in the field of biotechnology. Our analyses cover 101 regions from North-America, Europe and Asia-Pacific that developed substantial technological activities in the field of biotechnology over the period 1992-1997. The period of analysis corresponds with an era of rapid growth in the biotech industry in which industrial capabilities are evidently becoming more important. First, top regions in terms of biotech technology development are identified on a worldwide base. Next, the texture characteristics of regions in relation to their technological performance are studied and the determinants of global technological competitiveness of biotech regions are examined.

The paper is organized as follows: in the next section the role of science, knowledge generating institutes and private firms (small dedicated biotech firms and large pharmaceutical firms) for technology development in the field of modern biotechnology are discussed. Next, hypotheses are developed with respect to the distinctive characteristics of top regions in the growth phase of the biotech industry. Subsequently, data sources and variables used in the analyses are introduced. After presenting the empirical results, conclusions and policy implications are discussed.

2 The field of modern biotechnology

Modern biotechnology is a complex, knowledge-intensive field that has generated important breakthroughs for different industries, most notably the pharmaceutical industry (Arora & Gambardella, 1990; Zucker & Darby, 1997), by enabling the creation of entirely new organic materials and profoundly changing the process of (drug) discovery and product development (Gambardella et al. 2000, Powell et al. 1996). Of crucial importance for the origin of modern biotechnology was the discovery of the double helix structure of DNA (1953) by Watson and Crick in the laboratories of the University of Cambridge (UK). The foundation for the modern biotech industry was laid in 1973, when professors Cohen (Stanford University, US) and Boyer (University of California, US) discovered the recombinant DNA technique which allowed to transfer the basic science of molecular biology into useful knowledge for a wide range of industrial applications (Feldman, 2003), resulting in the creation of Genentech Inc. in 1976, one of the first biotechnology firms.

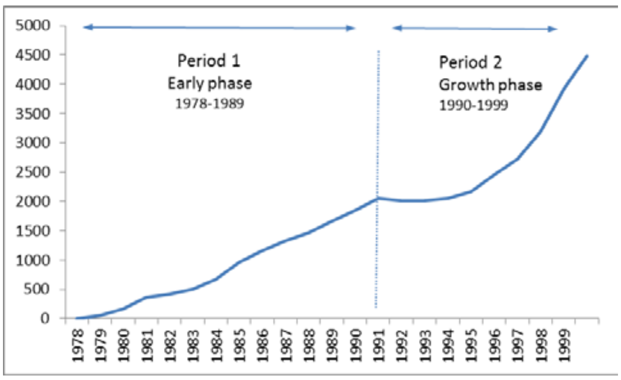
Following the discovery of the recombinant DNA technique, the second half of the 1970s and the 1980s was marked by the creation of the first companies dedicated to modern biotechnology, the so-called New Dedicated Biotech Firms (NDBFs). These new biotech companies were often cofounded by, or maintained strong linkages with academic researchers (Zucker & Darby, 1996). They focused on exploring new technological and scientific research results and translating them into the commercial domain (Acharya, 1999; Galambos, 2006). As new, scientific knowledge is often characterized by a substantial amount of tacit knowledge, developing an idea from science most often requires close links with the academic inventor(s) (Zucker & Darby, 1996; Rosenberg & Nelson, 1994) and NDBFs were therefore most often established in close vicinity of universities or research centres.

In the US, small research-intensive biotech firms set up to further explore and commercialise the results of scientific research, have significantly contributed to the development of biotech clusters. In the Greater Boston area for example, one of the first biotech clusters in the US, more than 50 biotech companies spun off from the Massachusetts Institute of Technology (MIT) and an additional 50 start-ups were founded by academic inventors of the university (Breznitz et al., 2008). The first mover advantage in the US in the growth small research-intensive biotech firms has been facilitated by supportive institutional arrangements such as the presence of venture capital and the Bayh-Dole Act (Owen-Smith et al., 2002). In addition, Owen-Smith et al. (2002) - when analysing the comparative advantage of the US in the field of biotechnology - point to the diversity in the organizations involved in research activities (universities, research institutes, hospitals, and small firms) and the support of the National Institutes of Health (NIH) enabling the integration between basic science and clinical development.

By the late 1980’s, large pharmaceutical firms started to display interest in the field of biotechnology. However, as the main knowledge base (organic chemistry) of these incumbent firms differed significantly from the science base of biotechnology (molecular biology), large pharmaceutical firms had difficulties to internalize this new knowledge (Zucker & Darby, 1997). From the early 1990s onwards, they entered into the field by setting up strategic alliances with and/or acquiring small biotech firms.

Several case studies provide evidence that large, established firms have played an important role in developing regional activities in the field of biotechnology: In the region of Basel (Switzerland), the strong presence of a pharmaceutical industry with firms like Novartis and Roche, has contributed to the growth of biotech in the region (Houlton, 2003); equally, in the Bioregion Rhineland in Germany, the presence of a chemical and pharmaceutical industry is considered to be "an advantage for the creation of an integrated biotech sector from research to production" (Zeller, 2001). Around the 1990's, mergers and acquisitions by large established players resulted in an upsurge of entrepreneurial activities in the field of biotechnology in the regions of Milan (Italy), Uppsala (Sweden) and San Diego (South California), leading to the emergence of totally new business structures in the region (Chiaroni & Chiesa, 2006). In the San Diego cluster for example, nearly 50 industrial spin-offs were created by former employees / scientists of the biotech company Hybritech, that left the company after Hybritech was acquired by the pharmaceutical company Eli Lilly.

Figure 1 presents the evolution of biotech technology development over the period 1978-1999, measured by the number of EPO patent applications (worldwide). The figure shows a steady, linear increase in the number of patent applications in the early phase of the biotech industry (period 1978-1990), followed by an exponential growth in the number of patent applications from the early 1990s onwards (Lecocq & Van Looy, 2009). This study focusses on the period 1992-1997, an era characterized by a regime of rapid technology development in the field of biotechnology.



(EPO Patents 1978-1999, worldwide)
Figure 1 Evolution of patenting in the field of biotechnology

3 Toward some hypotheses

Above studies seem to suggest the existence of different pathways of regional cluster formation with different types of actors leading the process of cluster emergence. Part of these differences in texture may also be related to life cycle dynamics with universities playing a main role in the early stages of the industry (period 1978-1989), while industrial capabilities are becoming more important after a “dominant design” sets in (Utterback, 1994) and technologies (products) are being commercialized (period 1990-1999). In order to profit from the take-off of economic activities in the growth phase of biotech, regions may benefit from a different configuration in terms of presence of (entrepreneurial) research universities and industry composition (presence of new dedicated biotech firms and more established firms) than in the early days of the industry. The question whether regions can evolve into leading clusters in the growth phase of the biotech industry by relying on a distributed texture or whether the presence and/or emergence of an anchor tenant firm is a prerequisite becomes a pertinent question. In this research, we look at the texture characteristics of regions in relation to the technological performance of regions during the rapid growth phase of biotech (period 1992-1997). Specific attention is given to industrial texture characteristics of regions and, since biotechnology is characterized by sophisticated and widely dispersed knowledge base, the entrepreneurial orientation of scientific actors in the regions as well as the extent to which regions engage in international R&D collaboration.

3.1 Industrial texture characteristics

By their nature and core raison d’être, firms are best placed to identify market needs, translate technological opportunities into prototypes and commercial products, and bring these new products to the market. Even in science-intensive fields such as biotechnology, private firms remain the major player on the market place. In regions with a critical mass of activities directed towards market exploitation and commercialization, firms have more opportunities to interact and learn from high-quality suppliers, demanding (industrial) customers and other innovative firms producing similar or complementary goods and services (Porter, 2000) resulting in enhanced innovation dynamics in the region.

The concentration of innovative activities within larger, R&D intensive firms might be of particular relevance for the development of a new industry because of their scale and access to larger financial resources as compared to new and / or small firms (Gray & Parker, 1998). By creating local niches and/or intermediary markets, larger firms may also encourage entrepreneurial activity in the region and attract high-quality suppliers which would not be present or of lower quality in the absence of the anchor firm (Agrawal & Cockburn, 2003). This leads to the following two hypotheses:

Hypothesis 1a: Regions in which technology development activities are to a larger extent driven by firms, are more likely to become a leading biotech region in the growth phase of biotech.

Hypothesis 1b: Regions with higher levels of concentration of technology development activities within an anchor tenant firm are more likely to become a leading biotech region in the growth phase of biotech.

3.2 The entrepreneurial orientation of knowledge institutes

In complex knowledge-intensive fields such as biotechnology, technology development builds to an important extent on scientific progress and a strong science base developed within public research institutes (Dosi, Llerena & Labini, 2006; Nelson, 1993; Owen-Smith et al., 2002). Several studies have shown that especially in science-based fields, the geographical proximity of universities and research laboratories matters, with local spillover effects resulting in increased number of company patents in the region (Leten et al., 2011; Anselin et al, 2000; Jaffe, 1989). Spillovers stemming from the local circulation of knowledge, are likely to be stronger when the knowledge institute(s) in the region take a more entrepreneurial attitude, with scientists actively involved in the innovation process through engagement in collaborative research with firms and/or the creation of academic start-ups (Siegel & Wessner 2012, Zucker et al., 2002). This leads to the following hypothesis:

Hypothesis 2: Regions with a strong entrepreneurial orientation of scientific actors, measured by technology involvement, are more likely to become a leading biotech region in the growth phase of biotech

3.3 International technology collaboration

Translating scientific advances into commercial applications requires specific skills and know-how which in an industry characterized by a regime of rapid technology development and a complex knowledge base such as biotechnology, most often does not reside within a single organization but has to be acquired through networks of learning (Powell et al., 1996). Indeed, the biotech industry can be considered as a system or network in which technology development relies to a large extent on inter-organisational collaborations between autonomous organizations with complementary resources, with universities and public research centres at the basis of new scientific knowledge, large pharmaceutical and chemical firms having the capabilities to market products (including experience with clinical testing, engineering know-how about manufacturing and access to commercial market), and new dedicated biotech firms often considered as the nexus between academia and large established firms (Mangematin et al. 2003; Arora & Gambardella 1990; Gambardella et al. 2000, Gertler & Vinodrai, 1996; Powell et al. 1996).

Even in the most dynamic clusters, firms and other innovation actors therefore need to take an outward stance, monitor and explore knowledge and technology developments outside the region (Porter, 1998) and engage into international technology collaborations with organizations with complementary knowledge and skills (e.g. Cooke, 2006; Zeller, 2001; Lecocq & Van Looy, 2009). Therefore, we propose that:

> *Hypothesis 3a: Regions that engage more in international technology collaboration with scientific actors are more likely to become a leading biotech region in the growth phase of biotech.*

> *Hypothesis 3b: Regions that engage more in international technology collaboration with firms are more likely to become a leading biotech region in the growth phase of biotech.*

4 Data

To identify the worldwide leading clusters in terms of biotech technology development and study the texture characteristics of biotech regions in a quantitative way, we draw on the dataset with EPO patent applications and Web of Science publications in the field of biotechnology created by Glänzel, Meyer, Schlemmer, Du Plessis, Thijs, Magerman & Debackere, (2004). All patents and publications with applicants or author addresses in Australia, Canada, Europe, Japan and the US have been withhold for this study. Together, these countries represent more than 97% of all patents in the field of biotechnology. We focus on the time frame 1992-1997, the period of rapid growth of the biotech industry.

The use of patent and publication data has several advantages (Griliches 1990, Jaffe 1989, Pavitt 1985). They are an important source of information about the time and location of technological and scientific inventions, as well as the organizations and institutions involved. In addition, patent and publication data have a global coverage and allows adopting a (technology) field-specific perspective. Combined with the address information of assignees, inventors and authors, patent and publication data allow to create indicators on the texture characteristics regions as well as their technological performance in the field of biotechnology on a global scale. At the same time, the use of patent data also has some deficits: not all inventions are patented and patented inventions may vary in technical and economic value (Mansfield 1986, Gambardella et al. 2008). Since patent analyses in this study are restricted to biotechnology, a field with a high propensity to patent, this should however not present a problem (Arundel and Kabla, 1998). Moreover, studies have provided evidence for a strong correlation between patent counts and other technological performance indicators such as innovation counts and new product announcements, establishing patents as a valid indicator at the level of regions (Acs et al. 2002) and firms (Hagedoorn and Cloodt, 2003; Narin and Noma, 1987). Moreover, no other data source provides such detailed and exhaustive data covering all countries, for long time periods and at the level of technologies and regions.

In a first step, all patents and publications have been allocated to their respective regions based on the address information of applicants (patents) and authors (publications) following the "patent allocation methodology" developed by Lecocq, Van Looy & Vereyen (2011). Table 1 shows, for every country, the regional level of analysis in this study. Only those regions that developed a substantial amount of biotech activity over the time period 1992-1997 (minimum 18 EPO patent applications, i.e. on average three patents/year) are retained for the analyses.

Australia	states (n=6) and major mainland territories (n=2)
Canada	provinces (n=10) and territories (n=3)
Europe (EU-15 + Switzerland)	nuts1/2 regions (n=197)
Japan	prefectures (n=47)
United States	states (n=51)

Table 1 Regional level of analysis

The "sector allocation methodology" developed by Du Plessis, Van Looy, Song & Magerman (2011) allows to identify by which type of actor (private firms, public universities and research centres, research hospitals and/or persons) a patent has been applied.

Based on the "name harmonizing method" of Magerman, Peeters, Song, Grouwels, Callaert & Van Looy (2011), the firm and/or other actor with the largest number of patents in the region is identified. In the study, we refer to those firms and other actors as the "lead company" and the "lead actor" in the region.

The "lead company" in the region is further classified as "New, Dedicated Biotech Firm" (NDBF), "Established Firm (EF) or "Other firm" according to the definitions in Table 2. This classification of firms relies on information on the industry(ies) in which the firm is (primarily) active, it's year of establishment and the location of it's headquarter retrieved from company websites and other websources such as reports on merger and acquisition activities and new product and technologies in the field of life science, market research reports and company profiles.

New Dedicated Biotech Firm (NDBF)	Firm primarily active in the field of biotechnology and established after 1974.
Established Firm (EF)	Firm primarily active in other fields than biotechnology (e.g. pharmaceutical, chemical, food and other industries) and established before 1974.
Other Firm	Firm active in the field of biotechnology but not as a product or research company (e.g. regional technology transfer offices, venture capitalist, regional industrial promotion agency)

Table 2 Refinement of the typology of firms

Table 3 provides an overview of the texture variables used in the regression analyses of the paper. The industrial texture characteristics of regions imply the count of firms in the region that are active in biotech technology development ("Number of firms") as well the degree of concentration of industrial biotech technology development within the leading firm in the region (measured by the concentration ratio, "Company concentration index"). As a measure for the scientific capabilities of regions, the number of publications normalised by population ("Science-intensity of the region") is used. This measure includes both publications from scientific actors and company publications. The ratio of the total number patents owned by knowledge institutes and total publications in the region ("Entrepreneurial orientation of knowledge institutes") is used as an indicator for the entrepreneurial attitude of the knowledge institutes in the region. Finally, co-patents between assignees from different countries are used as measures of international technology collaboration: based on the type of the foreign assignee, we distinguish between a) international technology collaboration with firms ("International collaboration with firms") and, b) international technology collaborations with knowledge institutes ("International collaboration with knowledge institutes").

Variable	**Description**
Number of firms	Number of companies active in biotech patent applications in the region.
Company concentration index	Ratio of the number of biotech patents of the leading firm in the region and the total number of company biotech patents in the region.
Science-intensity of the region	Number of biotech publications in the region per 1000 population.
Entrepreneurial orientation of knowledge institutes	Ratio of the total number of biotech patents applied by public knowledge generating institutes in the region and the total number of biotech publications in the region
International collaboration with firms	Number of biotech co-patents in the region with a firm from outside the country
International collaboration with knowledge institutes	Number of biotech co-patents in the region with a knowledge generating institute from outside the country

Table 3 Texture variables

5 Analyses

The history of the biotech industry illustrates that different types of actors ranging from private firms (new dedicated biotech firms and established firms) to public knowledge institutes and research hospitals are involved in biotech technology development. In this paper, the texture characteristics of regions in terms of presence and contribution of different types of actors, in relation to the overall technological performance of regions in biotech are examined during the rapid growth phase of biotech (period 1992-1997). First, the top regions in terms of biotech technology development are identified on a worldwide scale. Next, the overall relationship between the technological performance of regions and the share of biotech patents developed by private firms is examined. For the leading clusters, the type of actor (private firm, knowledge institute, hospital or individual) acting as the 'leading' organization in terms of regional technology development is further investigated. Based on more refined texture variables, differences in texture between leading regions are identified. In the last part of the analyses, panel-based regression models are used to analyse differences between leading versus other biotech regions in terms of texture characteristics.

5.1 Top regions in biotech

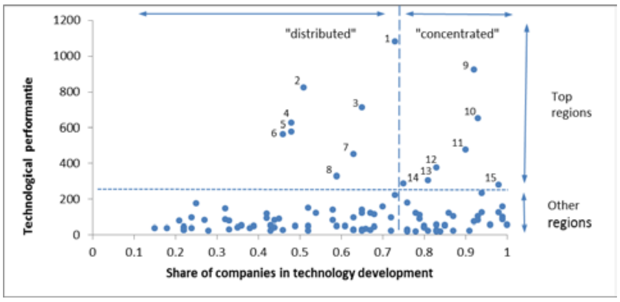
Regions with the highest count of biotech patents (based on assignee addresses) are considered as leading regions in biotech. Table 4 shows the 15 leading regions in biotech over the period 1992-1997. Most top regions are located in the US, e.g. North-California (San Francisco region), Massachusetts (Boston) and South-California (San Diego region). Japan has two top regions in biotech: Tokyo and Osaka. The three largest biotech regions in Europe are Île de France (Paris region, France), Denmark and London (United Kingdom). Biotech technology development activities are highly concentrated in a few regions or clusters worldwide: together the 15 leading regions in terms of biotech technology development account for 56% of all biotech patent activity.

Rank	**Region, country**	**Patents**
1	North California, US	1,083
2	Tokyo-TO, Japan	921
3	Massachusetts, US	824
4	South California, US	711
5	New Jersey, US	650
6	New York, US	626
7	Maryland, US	576
8	Île-de-France, France	563
9	Osaka-FU, Japan	477
10	Pennsylvania, US	449
11	Denmark, Denmark	376
12	Inner London, UK	328
13	Illinois, US	305
14	Karlsruhe, Germany	288
15	Nordwestschweiz, Switzerland	280

Table 4 Leading biotech regions (period 1992 - 1997)

5.2 Towards a typology of (leading) biotech regions

Figure 2 presents the technological performance of regions and the share of biotechnology development activity undertaken by private firms for the 101 regions in the study. The figure again confirms the strong geographical concentration of biotech technology development. Overall, no obvious, linear relationship can be discerned between the performance of regions and the share of technology development undertaken by private firms. On the one hand, one observes no 'top regions' when the share of companies (in terms of technology development) is situated below 40%. On the other hand, when looking at the leading regions only, we notice that in some regions technology development activities are very much concentrated within firms (share of company patents above 75%), while in other regions technology development is much more distributed over private firms and other types of actors (with the share of company-owned patent situated around 50%). These results indicate that to become a leading biotech region in the growth phase of biotech, regional technology development activities do not need to be primarily driven by private firms, so that hypothesis 1a only partly holds.



The top 15 leading regions in biotech technology development over the period 1992-1997 are 1. North California, US; 2. Massachusetts, US; 3. South California, US; 4. New York, US; 5. Maryland, US; 6. Île de France, France; 7. Pennsylvania, US; 8. Inner London, UK ; 9. Tokyo-TO, Japan; 10. New Jersey, US; 11. Osaka-FU, Japan; 12. Denmark, Denmark; 13. Illinois, US; 14. Karlsruhe, Germany; and 15. Nordwestschweiz, Switzerland.

Figure 2 The technological performance of regions and the share of biotech technology development activities undertaken by private firms

Annex 1 shows for each of the 15 main biotech regions, the lead actor(s) in the region where lead actor is defined as the organization with largest number of biotech patent applications in the years 1992 to 1997. For the leading biotech regions where technology development is highly concentrated within private firms (regions 9 to 15 on the right hand side in Figure 2), the leading organisation(s) in the region is always an established firm, mostly primarily active in pharmaceuticals. In the leading biotech regions where technological activity is much more distributed over private firms and other actors (Regions 1 to 8 in the middle of Figure 2), the leading organisation(s) in the region is always a combination of public research institutes (university, research centre or research hospital) and private firms (New Dedicated Biotech Firm or Established Firm).

The analysis of the texture characteristics of the top biotech regions thus provides evidence for the presence of two types of regions: regions in which technology development is mainly situated or concentrated within private firms – hereafter called "concentrated regions" - and regions where technology development is more equally distributed between private firms, and entrepreneurial universities and/or research centres/hospitals hereafter referred to as "distributed regions". Figure 1 shows that both a distributed and a concentrated texture can give rise to a leading technology cluster in biotech. The T-test statistics on the refined texture variables in Table 5 further reveal some distinct features of "distributed" versus "concentrated" biotech regions. "Concentrated" regions are characterized by a higher share of technology development activities by private firms. Technology development activities by private firms is also much more concentrated into the leading firm than in the "distributed" regions. "Concentrated" regions also engage more in international technology collaborations with knowledge generating institutes. Meanwhile, "distributed" regions are characterized by a higher science-intensity of the region, measured by the number of publications per population, as well as the presence of universities and research centres with a stronger entrepreneurial orientation.

	Top distributed regions (n=8)	Top concentrated regions (n=7)	difference	t-test
Share of company patents	0,58	0,89	-0,32	-14,1 ***
Intl coll with knowledge institutes	0,65	1,38	-0,74	-2,7***
Intl coll with firms	0,88	0,95	-0,08	-0,3
Entrepreneurial orientation of knowledge institutes	0,014	0,004	0,010	11,9***
Company concentration index	0,28	0,42	-0,14	-3,2***
Number of firms	23,7	20,3	3,40	1,0
Science-intensity of the region	0,31	0,24	0,07	2,3**

Table 5 T-test statistics on leading "distributed" versus "concentrated" regions (yearly figures, period 1992-1997)

5.3 What differentiates leading regions?

During the period 1992-1997, we find evidence of regions catching up and regions falling back in the ranking of leading biotech regions. In regression models that follow, panel data for the 101 biotech regions are used to analyse which texture characteristics differentiates leading regions from other biotech regions, by means of logit models with the following functional form:

P(yit = 1 / xit) with t = 1-7, xit contains the explanatory and the control variables

The dependent variable in the logit regression models is a dummy which takes the value 1 if the region is among the top 15 regions in year t, or else the value 0. Random effects take into account and control for the panel structure of the data. The explanatory variables are the texture variables presented in Table 3 of the data section: the science-intensity of regions, the company concentration index, the number of firms active in biotech, the entrepreneurial orientation of knowledge institutes, international collaboration with firms and international collaboration with knowledge institutes. Controls are included for the size of the regions (measured by its population) and for time-specific effects. A US dummy variable is used to control for a possible "first mover"-effect of US regions in the field of biotechnology.

Table 6 shows the results of the logit regression models. Model 1 includes all 101 biotech regions. As previous results showed that leading regions have different texture characteristics, separate analyses for the regions with a "distributed" texture (n= 64) and the regions with a "concentrated" texture (n=37) are presented in Model 2 and Model 3 respectively. "Concentrated" regions have been defined as regions in which technology development activities is predominantly situated within private firms (share of company patents >= 0.75) and the leading player in the region (period 1992-1997) is an established firm.

	Model 1	Model 2	Model 3
	All Regions	**Regions with distributed texture**	**Regions with concentrated texture**
Science-intensity of the region	17.56** (7.89)	86.18*** (25.07)	52.39*** (17.34)
Number of firms	0.69*** (0.18)	2.17** (0.87)	0.92** (0.41)
Company concentration index	6.14** (3.02)	-22.77 (23.41)	25.34*** (9.56)
Entrepreneurial orientation of knowledge institutes	201.14** (102.21)	1479.37*** (557.68)	504.07 (329.23)
Intl coll with knowledge institutes	1.28** (0.60)	3.36 (5.24)	4.32*** (1.25)
Intl coll with firms	-0.41 (0.57)	-1.98 (3.08)	-0.31 (0.99)
Population	0.0005 (0.0003)	0.0007 (0.0006)	0.0032*** (0.0012)
US dummy	-0.23 (1.96)	14.24* (7.57)	-6.07 (6.38)
Time	-0.78*** (0.29)	-0.87 (1.16)	-2.52*** (0.76)
Constant	-19.06*** (5.03)	-75.49*** (18.35)	-51.66*** (10.34)
Observations	606	384	222
Loglikelihood	-525.07	-9.86	-27.23
P	0.0086	0.0021	0.0004

*, **, *** *indicate significance at the 10% 5% and 1%. Standard deviation between brackets*

Table 6 Random Effect Logit models

The results in Table 6 (Model 1) reveal that leading biotech regions are more science-intensive and count a higher number of firms active in biotech technology development. These results hold for both “distributed” (Model 2) and “concentrated” regions (Model 3) and affirm that in science-intensive industries such as biotechnology, the continuous development of a strong science base remains important, also in the growth phase of the technology. At the same time, the results indicate that regions can only become top by the constant creation or attraction of companies active in biotech technology development.

The regression results in Model 3 further reveal that leading biotech regions with a “concentrated” texture not only have a higher number of firms active in biotech technology development; higher levels of concentration within an ‘anchor tenant’ firm are instrumental for a leading position as well. These results confirm that for regions with a “concentrated” texture, hypothesis 1b holds: regions with higher levels of concentration of regional biotech technology development activities within an anchor tenant firm are more likely to become a leading biotech region in the growth phase of biotech.

Next, the regression results in Model 2 show that top “distributed” regions are characterized by a stronger entrepreneurial orientation of the knowledge institutes in the region, while no significant impact is found for the “concentrated” regions (Model 3). The results indicate that hypothesis 2 hold for “distributed” regions: regions with more entrepreneurial-orientated scientific actors are more likely to become a leading biotech region in the growth phase of biotech.

Finally, the analyses in Model 3 reveal that “concentrated” regions, in which a positive impact of entrepreneurial-oriented institutes is largely absent, do benefit from international technology collaborations with knowledge institutes. For the “distributed” regions (Model 2), no similar effect is found in terms of international collaboration. The results also reveal no significant impact from international technology collaborations with firms. As such, the regression results confirm hypotheses 3a for the regions with “concentrated” texture characteristics: Regions that engage more in international technology collaboration with knowledge institutes are more likely to become a leading biotech region in the growth phase of biotech. No evidence is found for hypotheses 3b regarding technology collaboration with private firms.

6 Discussion and conclusion

Biotech technology development activities are highly concentrated in a limited number of top regions or clusters worldwide (Audretsch & Feldman, 1996; Feldman & Florida, 1994). In this paper, the texture characteristics of regions (industry composition, presence of entrepreneurial-orientated scientific actors and international technology collaboration) are examined that are instrumental for becoming a top biotech region in the period 1992 - 1997. The period under study corresponds with an era of rapid growth in the biotech industry in which industrial capabilities are evidently becoming more important.

Our results provide evidence for the presence of two types of leading biotech regions: “concentrated” regions in which technology development is mainly situated within private firms and “distributed” regions where technology development is more equally shouldered by private firms, entrepreneurial universities and/or research centres/hospitals. These results indicate that to become a leading biotech region in the growth phase of biotech, regional technology development activities do not need to be primarily driven by private firms.

Further, our analyses indicate that regions with “concentrated” texture characteristics benefit, in terms of overall technological activity, from increased levels of concentration of technology development activities within a leading firm, thereby supporting the anchor-tenant hypothesis proposed by Agrawal & Cockburn (2003). Further research reveals that the “anchor” firm(s) in the leading “concentrated” regions are large, R&D intensive firms primarily active in the pharmaceutical, chemical, food and other industries, and established well before the creation of the first dedicated biotech firms in the second half of the 1970s. Our analyses suggest that these large, established firms, which have extensive industry experience and important access to (internal) financial resources, have been of particular importance for the development of regional biotech technology activities in the first growth phase of the biotech industry. Following Agrawal & Cockburn (2003), such large, R&D intensive firms, by creating local niche and/or intermediary markets, may have played an important role in breeding regional entrepreneurial initiatives in the field of biotechnology and attracting high-quality suppliers to the region. Our results also indicate that regions with a "concentrated" texture benefit from engaging in international technology collaborations with scientific actors. In science-based industries such as biotechnology, developing relevant and highly-specialized scientific knowledge within the region also remains essential (see also Anderssen, 2001; Glänzel et al., 2004).

While the role of science and entrepreneurial-orientated universities and research centres is widely acknowledged for the early, incubation phase of new, science-based technologies, our study shows that in the growth phase of the biotech industry, the orientation and contribution of scientific actors in terms of technology development is positively influencing whether or not regions with more "distributed" texture characteristics evolve to become top regions. Indeed, our results show that top "distributed" regions benefit, along with an excellent science base, from a more entrepreneurial orientation of their knowledge institutes. To become a leading region, regions with a "distributed" texture also have to create sufficient industrial activities in the field of biotechnology, by generating new entrepreneurial activities in the field of biotechnology or attracting new firms in the region. Also the continuous investment in a strong science base remains important in the growth phase of science-based industries.

For practitioners and policy makers engaged in regional economic development, the observation of substantial heterogeneity between biotech regions in terms of texture characteristics, points to the relevance of policy measures tailored to the specific texture characteristics and strengths of a region, in order for a region to develop into a top region in biotech.

Acknowledgments

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[i] The Bayh-Dole Act (1980) allows - and even encourages - US universities to appropriate the results of publicly funded research through patenting.
[ii] The state of California (US) was split in North and South California as the state covers 2 large and distinct biotech clusters. Three outlier regions have been removed.
[iii] Nuts1 level was selected for the smaller European countries (Austria, Belgium, Greece, and Ireland), while nuts2 level is used for the other countries of the EU-15 and Switzerland.

[iv] Information on the (headquarter) location was matched with the address information on the patent to ensure the information retrieved via web sources corresponds with the assignee (company) of the patent application.
[v] Since the 1990s have been characterized by a lot of merger and acquisition activities in the field of biotechnology, but also because of the high failure rates of new (biotech) companies, we had to rely on exhaustive web searches to find company information, especially for the companies that no longer exist today, exist under a different name or have been acquired in the meantime.

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Annex 1 Leading organisations per region (period 1992 - 1997)

	Organisation name	Organisation type
North California, US	Genentech Inc. Incyte Univ of California	NDBF NDBF University
Tokyo-TO, Japan	Ajinomoto Co., Inc. Kyowa Hakko Kogyo Co., Ltd.	EPF EF
Massachusetts, US	General Hospital Corp. Genetics Institute	Hospital NDBF
South California, US	Amgen Gen-Probe Incorp. Scripps Research Institute	NDBF NDBF Research Center
New Jersey, US	Becton Dickinson & Co. Merck	EPF EPF
New York, US	Bristol Myers Squibb Co. Johnson & Johnson Ludwig Institute for Cancer Research New York Univ	EPF EPF Research Center University
Maryland, US	Department of Health and Human Services Human Genome Sciences, Inc.	Research Center NDBF
Île de France, France	INSERM Institut Pasteur Rhone-Poulenc AG	Research Center Research Center EF
Osaka-FU, Japan	Ono Pharmaceutical Co., Ltd. Sumitomo Electric Industries, Ltd. Suntory Limited Takeda Chemical Industries, Ltd.	EPF EF EF EF
Pennsylvania, US	Bayer AG Smithkline Beecham Univ of Pennsylvania	EF EPF University
Denmark	Novo Group	EPF
Inner London, UK	Cancer Research Campaign Technology Ltd. Medical Research Council Unilever Zeneca	Other Firm Research Center EF EPF
Illinois, US	Abbott Laboratories	EPF
Karlsruhe, Germany	Roche Diagnostics	EPF
Nordwestschweiz, Switzerland	F. Hoffmann-La Roche AG Novartis	EPF EPF

EPF: Established Pharmaceutical Firm; EF: Established Firm; NDBF: New Dedicated Biotech Firm

University-Industry Collaboration And Knowledge Transfer In The Open Innovation Framework

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Abstract
Globalization, pervasiveness of information and communication technologies, and the build-up of knowledge society and related policies have led to growth and redistribution of knowledge and highly trained labour supply. The foundation of competitiveness is now more dependent on valuable knowledge resources that are distributed widely across the globe, across actors in the value chains and across highly-skilled individuals in multiple organizations. Against this backdrop, the paradigm of open innovation (OI) has emerged as a new response to manage the increased amount of boundary-spanning knowledge flows in and out of the innovation process. It is essentially a framework for the comprehensive structuring and management of cross-boundary knowledge flows with the aim of improving innovation performance of organizations involved. As such, OI encompasses a wide range of collaboration modes, technology transfer and university-industry collaboration included. However, most of the open innovation literature focus on business-to-business transactions while research on open innovation activities in public-private partnerships (PPP) is only about to start a research agenda. Furthermore, universities are typically seen in the role of suppliers of knowledge without discussing other potential roles and objectives that universities may have in OI partnerships or networks. The goal of the paper is to explore these alternative roles by reviewing the literature on open innovation with a specific focus on university-industry collaboration. The paper finds that the role of universities as utilisers of external knowledge presents a clear gap in our knowledge of university-industry collaboration. The resulting literature synthesis also allows further elaboration on the emerging approach of open innovation in university-industry collaboration and identifies the essential gaps in the research, finally concluding with a proposed research agenda.

Keywords
University-industry collaboration, open innovation, knowledge transfer, literature review, innovation management.

1 Introduction

Open innovation research has focused predominantly on studying inbound modes of open innovation and on the viewpoint of commercial firms (Enkel et al., 2009). University-industry collaboration, on the other hand, has been studied under various contexts but with works mainly focusing on the influence of university-industry relations, or 'links' (Perkmann et al., 2012), on the basic functions of the university: scientific research and education.

Our research sets out to uncover answers to questions residing at the intersection of these two theoretical frameworks. The aim is to review knowledge transfer literature in order to demonstrate that there is a gap of knowledge on the university-industry collaboration where universities are utilizing firm-based knowledge as a starting point of research and development activities. Utilization of firm-based knowledge is addressed in open innovation literature, but, usually in the context of business-to-business collaborations. Our second aim is, thus, to review open innovation literature and display to what extent insights and analytical concepts of open innovation literature can be utilized in the study of knowledge transfer activities in public private partnerships (PPPs), particularly in university-industry collaboration.

We performed a simplified systematic review of the literature at the intersection of open innovation and university-industry collaboration research. The aim was to establish the state of current knowledge in the field (Tranfield et al., 2003) and to seek where the two conceptually close streams of literature could inform each other. A further motivation was to update and complement the review by Perkmann and Walsh (2007). The final objective of the review was to build understanding and an agenda for further research regarding the reverse direction of knowledge transfer in university-industry collaboration.

Our analysis is focused on the organizational, institutional and policy levels as we are interested in informing HEIs about the organizing of such knowledge transfer and policymakers about facilitating this important link in the knowledge triangle of the government, universities and firms. Our systematic review procedure is summarized in Figure 1. We conducted the search from 2002 (the first mention of the concept of open innovation in literature) to the current day, April 2013. The search was targeted to published peer-reviewed articles held by the Web of Knowledge database by using the keywords of ‘open innovation’ and ‘university’ to list all articles where both were found in title, abstract or keywords. This initial search yielded 132 results, which were then filtered according to scientific discipline to exclude articles focusing on natural sciences and leaving us with 80 articles. We manually screened these articles for fit based on abstracts thus eliminating all but 35 articles that formed our final sample.

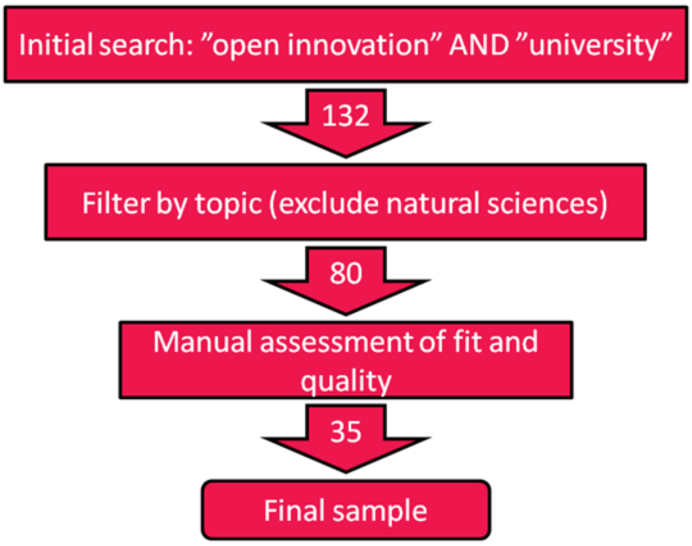

Figure 1: Search methodology for open innovation literature review

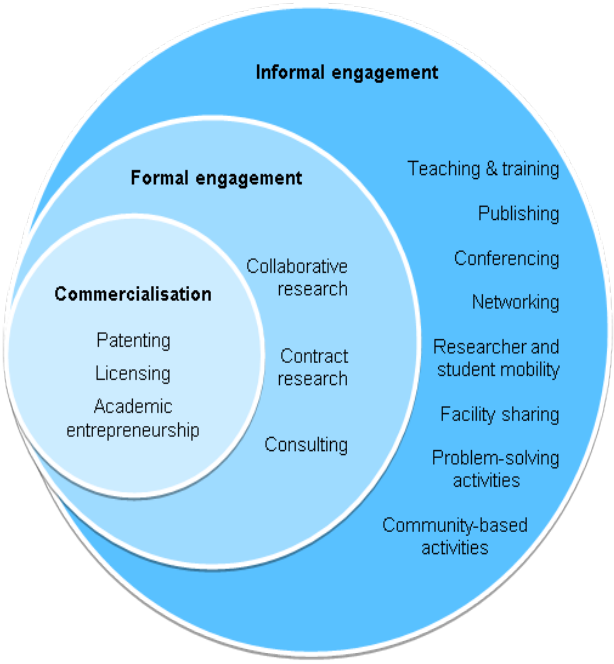

Figure 2: The different forms of knowledge transfer between universities and external actors. Cf. Perkmann et al 2012; Salter & Martin 2001; Abreu et al. 2009.

The paper is structured as follows. First, our research is positioned conceptually by reviewing the spectrum of links between universities and external organizations and their features in relation to our study focus (Figure 2). Then we present a systematic review mapping the intersection between the literatures of open innovation and university industry collaboration and finally present our findings along with an agenda for further research to explore this promising space.

2 Commercialisatoin of publicly-funded research

Many policy initiatives, like Bayh-Dole Act of 1980 and similar legislation in Europe (e.g. OECD 2003) have aimed at encouraging universities to engage in patenting, licensing and creating new business (Baldini 2006; D'Este & Patel 2007). In line with policy incentives, much of the literature on the university–industry collaboration has centred on the academic capacity to generate intellectual property rights (e.g. Thursby & Sukanya 2002; Friedman & Silberman, 2003; Jensen et al., 2003; D'Este & Patel 2007). However, commercial collaboration is not a general phenomenon in academia, and only a small proportion of researchers are actually involved in entrepreneurial activities (D'Este & Patel 2007). According to previous studies (Bozeman & Gaughan 2007; Lissoni 2008) roughly 5 per cent of academics have filed a patent. It is also noteworthy that patenting rates vary strongly between disciplinary cultures focusing most on technical sciences (Balconi et al. 2004; Himanen & Puuska 2011, 41-42).

There is a plenty of research on the motives and threats experienced by academics who get involved with commercial collaboration. In the literature, the benefits of collaboration to researchers and universities have been identified as knowledge- and property-focused advantages (Bozeman et al. 2013). Motivation to get financial or commercial gains has been remarkably low in comparison with knowledge-focused motivations (Abreu et al. 2009, 35; D'Este & Perkmann 2011). There are more valuable things than pecuniary benefits that are urging researchers to collaborate. Aiming to academically valuable insights and ideas, learning, access to funding sources, materials and data or in-kind resources, among others, have encouraged researchers to collaborate with industry. (D'Este & Perkmann 2011; Bozeman et al. 2013).

What comes to the threats of commercial collaboration, academics perceive rewards for faculty involvement in university knowledge transfer activities insufficient (Friedman & Silberman 2003; Siegel et al. 2003). The entrepreneurial activities of universities may set limits to publishing and the free exchange of data and insights (Florida 1999; Smith & Korn 2000). Also, the time consuming nature of legal and bureaucratic commercialisation processes takes time from research (Jensen et al. 2003; Baldini 2006). Moreover, there is a risk that academic entrepreneurship affects peer learning when everybody is tied up watching for their own pecuniary gains (Stephan 2001).

3 Formal and contract-based collaboration

According to a recent study on knowledge transfer in Europe (Arundel et al. 2013), commercial collaboration is a modest activity in European universities and highly concentrated in biomedical research. The license income only equals 1.5% of the research expenditures of public research performers. The top 10% of European universities and research institutes earns approximately 85% of all license income (€346 million) and 88.8% of the revenue comes from biomedical inventions.

Not surprisingly, industry values other channels of university knowledge transfer more than licensing, namely, consulting, contract research and cooperative ventures (Cohen et al. 2002). Consulting is about research or advisory services provided by academics to industry (Perkmann & Walsh 2007). In contract research, industry commissions researchers to perform research that usually takes place without public subsidies and is aimed at direct research applications relevant to industry. Collaborative or joint research is often publicly supported and has more basic research focus than that of applications (D'Este & Perkmann 2010). In most cases, consulting, contract research and collaborative research are formal engagements in terms of contracts, division of labour and project organisation.

While its significance is acknowledged, consulting, contract research and collaborative research are much less studied than commercial collaboration in terms of knowledge transfer (cf. Perkmann et al. 2012). It has been, however, noticed that knowledge transfer works in both ways from industry to universities and vice versa. As Cohen et al. (2002, 21) comment their survey results of the R&D managers of the US industry: "…public research provides ways of solving problems at least as often as it suggests new project ideas."

4 Informal collaboration

When it comes to technology transfer and knowledge mobilization between public research organizations and industries, the existing literature concentrates on formal channels, such as patenting, licensing, spin-off companies and collaborative research (Link & al. 2007, 642). When we move from formal to informal transfer mechanisms the picture becomes more varied and a whole diversity of interaction channels can be identified. These mechanisms, sometimes regarded as equally or even more important than the formal ones (Siegel & al. 2003, 41; D'Este & Patel 2007, 1297), include publishing, conferencing, personnel mobility, facility sharing, teaching and training as well as problem-solving activities of various kinds. Of these informal mechanisms of knowledge mobilization, the most important ones are publications, conferences and other types of information exchange, all of which were reported as important sources of research knowledge by 35-42 per cent of industrial R&D managers across all sectors (Cohen & al. 2002, 15; see also Siegel & al. 2003; D'Este & Patel 2007). A more recent survey by Bekkers and Bodas Freitas (2008) reported a similar kind of result with the distinction that personnel mobility belonged to the most important interaction mechanisms. Furthermore, the size of the company involved in interaction had a role to play in this study: while formal collaboration arrangements were favoured by large firms, small companies with few resources benefitted from informal mechanisms.

Although we are not able to discuss the topic any further here, one should also notice that the importance of informal university-industry interaction, in general, and different mechanisms used in it, in particular, differ significantly from country to country and from one field of industry to another. Of the informal mechanisms, publications and participating in conferences were found to be very important in a small number of science-based industries, such as biotechnology and pharmaceuticals, and moderately important in a wide range of manufacturing sectors. Personnel mobility, on the other hand, was essential not only in biotechnology but also in various fields of engineering, chemistry and information technology. (Bekkers & Bodas Freitas 2008; Cohen & al. 2002; see also D'Este & Patel 2007) In different fields of social sciences, staff mobility and training courses for firms were the most important knowledge transfer activities (Bekkers & Bodas Freitas 2008, 1839).

Despite the fact that several articles emphasise that knowledge and technology transfer work in both directions (Siegel & al. 2003; D'Este & Patel 2007; Link & al. 2007), there are relatively few studies that analyse transfer of assets from industry to university. Among the most important ones in this respect is the large-scale survey by D'Este and Patel (2007) who concluded that academics interact with industry, not only because of personal financial gain and additional research funding (Link & al. 2007, 643), but also in order to get access to industry skills and facilities and to keep abreast of applied, industrial problems: "Interaction with industry practitioners exposes university researchers to a wide range of technological problems identified by industry, opening an array of research avenues that would not have emerged had researchers remained within the boundaries of university research" (D'Este & Patel 2007, 1297).

Additional results emphasising different kinds of benefits university researchers gain from knowledge and technology transfer with industrial partners have been published by Link and others (2007, 643) as well as Siegel and others (2003). In these studies important motivational factors contributing to the interest by university researchers to become engaged in informal industrial collaboration were issues like professional development and increasing quality and quantity of their academic research. Indeed, the total of 65 per cent of the scientists interviewed by Siegel and others (2003) claimed that industrial interaction has had positive influence on their experimental work at universities.

5 The open innovation framework and university-industry collaboration

Open Innovation can be characterized as a framework for organizing and managing boundary spanning knowledge flows connected to the innovation processes of organizations (Kutvonen, 2012). Universities have long been acknowledged as an important source of industrial innovation and as such present a special case of open innovation (Perkmann & Walsh, 2007). Their role so far has been researched nearly exclusively as suppliers of specialized knowledge or technology assets within inbound open innovation, thus ignoring other potential roles that they may hold in innovative collaboration setups.

Following the propositions of public-private partnership and regional innovation research (Cooke, 2008), universities carry a central role, especially in regional contexts, that goes beyond only supplying technology and trained knowledge workers and is rooted in bidirectional or networked modes of collaboration rather than unidirectional knowledge transfer (Meyer-Krahmer and Schmoch, 1998; Perkmann & Walsh, 2009) thus pointing to coupled open innovation modes being critical to realizing their potential impact. Furthermore, understanding the coupled open innovation mode and managing the potential synergies in parallel external acquisition and exploitation activities is according to Lichtenthaler (2011) one of the key contributions of the open innovation framework. Our objective in this section of the paper is thus to summarize the state-of-the-art in what is known of coupled modes of open innovation collaboration between universities and other organizations. This is achieved by reviewing the literature in the intersection between university-industry collaboration literature and open innovation literature through a systematic review, the result of which is summarized in the appendix.

Open innovation research has focused predominantly on studying inbound modes of open innovation and on the viewpoint of commercial firms (Enkel et al., 2009). University-industry collaboration, on the other hand, has been studied under various contexts but with works mainly focusing on the influence of university-industry relations, or 'links', on the basic functions of the university: scientific research and education.

Perkmann and Walsh (2007) performed a literature review where they proposed that university-industry links where a strong relational aspect (as a prerequisite for tacit knowledge transfer) could be identified would qualify within the open innovation framework, whereas other modes of collaboration represented mainly uni-directional technology or knowledge transfer, or personnel mobility. They propose that links with high relational involvement would include research partnerships and services, while modes of collaboration focused on commercialization of IP, such as licensing, would indicate low levels of involvement. This view is somewhat contradictory to most open innovation studies on firms which count in- and out-licensing as essential governance modes of open innovation (Chesbrough, 2003; Enkel et al., 2009) and emphasize that they also regularly involve extended periods of negotiation and mutual involvement of R&D staff to secure successful knowledge transfer and learning benefits (Lichtenthaler, 2007; Kutvonen et al., 2010).

Levy et al. (2009) concur with Perkmann and Walsh (2007) and focus their study on channels associated with ‘two-way interactions’ but note that collaborations may consist of multiple collaboration projects, which again may include use of several channels, thus raising questions about the focus of prior research on comparing the importance of individual channels. They find four distinct patterns of collaboration utilized by firms and link them to ‘relational logics’, which describe assumed motivations of firms to collaborate in a given way. These are the proximity logic (implying close and continuous relationship with bidirectional tacit knowledge exchange yet aim for private benefit), club logic (where multi-partner collaboration leads to pre-competitive technologies), market logic (dyadic relationships on demand to solve specific bottlenecks in innovation) and open science oriented logic (where the knowledge exchange and collaboration are ends on to themselves or a part of continuous technology exploration and scouting).

6 Finding: Turning the tide - universities as utikusers of unused intangible assets of firms

Prior literature on open innovation and university-industry collaboration have proposed elements to initiate a research agenda at the intersection of open innovation and knowledge transfer literature. West et al. (2006) suggested searching and matching processes that precede university-industry relationships and researching the organization and management of such collaboration arrangements. Perkmann and Walsh (2007) add to this by specifying the two avenues of research further, noting e.g. the need for research concerning firms’ strategies in establishing and managing university-industry relationships and to the influence of institutional structures and national innovation systems in shaping the organization of university-industry collaboration. Perkmann and Walsh (2009) suggest that university-industry relationships constitute a two-way

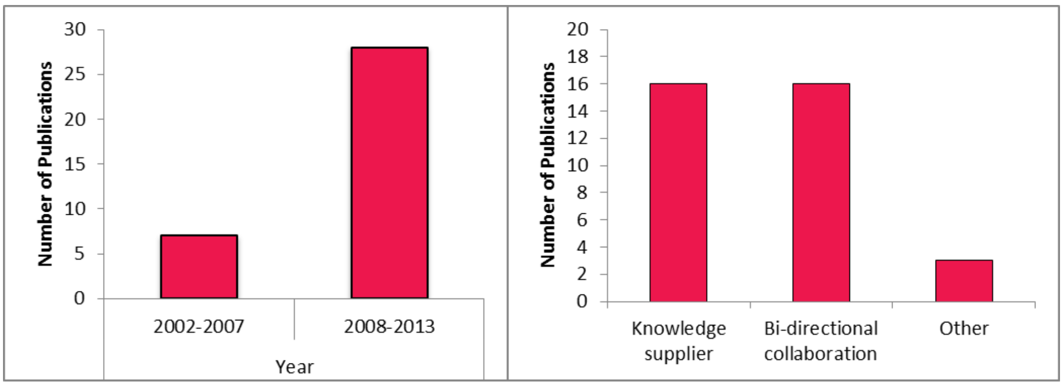

Figure 3: Publication analysis

exchange rather than a one way transfer of university generated technology. Interestingly, this view of bi-directional collaboration is shared only with less than half of the papers within our sample (Figure 3.). This emphasis on mutually beneficial give-and-take relations in collaboration has constantly increased in prominence, along with the adoption of the open innovation concept or terminology in the papers. We find also that the amount of research combining notions of openness and university industry collaboration has seen accelerating growth, signaling that there is demand for analytical research utilizing the open innovation framework to address questions in university-industry collaboration.

7 Conclusion and next steps

Our systematic analysis of literature on open innovation with a specific focus on university-industry collaboration suggests that the research on this topic has accelerated over the last five years (Figure 3.). It is worth noticing, however, that most of the research does not operationalize the analytic concepts of open innovation literature, such as inbound and outbound innovation activities. Open innovation is mostly referred to as an umbrella term to which the research in question has loose associations and connections.

There are only a handful of studies where the role of universities as utilizers of firm-based knowledge is scrutinized (e.g. Young et al., 2008; Malik et al. 2011). Interestingly, the role of universities as knowledge utilizers as well as the bidirectional relationship between universities and firms, are brought to the research agenda simultaneously with the use of the analytical concepts of open innovation literature. This implies that the insights of open innovation literature play a significant role in the expansion of the research focus of knowledge transfer literature.

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Appendix: Systematic review results

Author(s), year	**Level of analysis**	**Main topics covered**	**Findings**	**University role / interaction**
Bodas Freitas, Geuna & Rossi (2013)	Organization-level	Distinction between institutional and personal contractual governance; which types of firms elect to use which mode	Personal contractual arrangements with individual researchers represent close to 50% of all university–industry interactions. Large firms favour institutional governance while small and/or technology-open firms favour personal contractual governance.	University as knowledge supplier
Alexander & Martin (2013)	Organization-level	Capabilities and strategies of technology and knowledge transfer offices.	Conceptual model built on four core competences that enable transfer offices' operations: Set up and manage a research project, Knowledge sharing and support to enterprises, Boundary-spanning through HR and Patent and entrepreneurship.	University as knowledge supplier
Comacchio, Bonesso & Pizzi (2012)	Organization-level	Ability of technology transfer centres to foster university-industry collaboration	TTCs need to perform scanning and selection of R&D opportunities, bridge building, semantic translation of domain specific knowledge and engender co-production of knowledge to bond the academic and industrial systems. This requires both technical and networking skills, task coordination and qualified social capital.	Bidirectional collaboration
Tijssen (2012)	Publication-level	Large-scale systematic measurement of public-private co-publications	PPC data and metrics need to be situated to the context of their relative scientific and industrial fields and applied rather at the level of city agglomerations (NUTS3) than larger provinces.	Bidirectional collaboration
Roper & Arvanitis (2012)	Policy-level	How has innovation contributed to the growth of economy in Switzerland versus Ireland	Internal and external sources of knowledge complement each other in innovation sourcing, emphasizing importance of in-house R&D. Institutional and historical contexts also influence the relationship between innovation and productivity.	University as knowledge supplier
Nunez-Sanchez, Barge-Gil & Modrego-Rico (2012)	Project-level	Scientific and techno-economic impacts of public research centres (PRC) and industrial firm collaboration and pre-project determinants thereof	Prior experience is highly important for techno-commercial outcomes, but not for scientific performance. PRC collaboration motives matter: if PRC are seeking technical knowledge, the likelihood of producing patents decreases, while financial motives are beneficial to collaborative outcomes, as well as firm commitment. Communication process quality also impacts outcomes, while coordination only improves techno-economic results.	Bidirectional collaboration
Howells, Ramlogan & Cheng (2012)	Organization-level	Nature and impact of higher education institutions collaboration on firms' innovation and	The effect of HEI collaboration on firms' innovativeness and growth is highly diversified and contingent on the type and location of the firm.	Bidirectional collaboration

		growth.		
Hewitt-Dundas (2012)	Organization-level	Is knowledge transfer activity dependent on the research performance / research intensiveness of the university?	High research intensive (HRI) universities emphasize IP enabled knowledge transfer and low research intensive (LRI) human capital development. Proportionally, LRI universities are more active regionally although HRIs have a larger scale and scope of transfer activity in total	Bidirectional collaboration
Krishnan & Jha (2012)	Organization-level	Collaboration characteristics of Indian automotive companies and universities	Indian automotive companies' collaboration is focused on competency development, training and utilization of technical research services, such as testing and analytical services. Government support may be crucial for intensifying collaboration between universities and firms	University as knowledge supplier
van Geenhuizen & Soetanto (2012)	Organization-level	Utilization of open innovation in university spin-off companies and the role of cities in supporting it	Spin-offs lack resources in understanding and accessing markets. Regionally or locally confined learning networks are not sufficient to respond to this deficiency thus implying need for more open approaches, where active promotion and support of city governments may help.	University as knowledge supplier
Kruss, Adeoti & Nabudere (2012)	Policy-level	African innovation systems and conditions for university-industry interaction within	Sub-Saharan African (and other low-income) developing countries face unique challenges that prevent them from directly imitating established policy models.	University as knowledge supplier
Lei et al. (2012)	Policy-level	Three models of university-industry-government (Triple helix) relations and their relation to inventive activity and collaboration in China.	University and industry collaboration is the strongest within the Triple Helix, while other relations remain weak. China has evolved from etatistic model through 'laissez-faire toward a triple helix. Innovation is centred in private and foreign enterprises.	Bidirectional collaboration
Dabic & Svarc (2011)	Organization-level	The emergence of the concept of 'entrepreneurial university' and the forces of change behind this new model	Drivers of change include reduction of budgets, renewed concept of the role of universities that now includes economic development responsibility and globalization and internationalization that heighten competition.	University as knowledge supplier
Lazaro, de Andoain & Ruiz (2011)	Organization-level	Describing the knowledge management approach at a single university	Knowledge management at Polytechnic University of Madrid aims at attracting a good level of resources, students and reputation. They address this by developing remote education, innovation policies, information systems to store questionnaire data and personnel.	University as knowledge supplier
Al-Ashaab et al. (2011)	Organization-level	Measuring collaboration outcomes via a Balanced Scorecard (BSC) method	Two cases of applying the collaboration BSC developed within the paper are presented along with a list of 26 key performance indicators that may be used.	University as knowledge supplier
Malik, Geor-	Organization-	Organization, perfor-	UIC provides a platform for building a	Bidirectional

ghiou & Grieve (2011)	level	mance and characteristics of University Innovation Centers (UIC) through single case study	deep open innovation themed strategic alliance between a firm and an university. They align the research interests of the two parties while granting universities with more resources but limiting their freedom in disseminating results; companies gain access to knowledge and personnel while requiring significant commitments.	collaboration
Mayer (2010)	Policy-level	Impact of open innovation on state public policy and implications for weak R&D states: is open innovation a part of weak R&D states' policies?	There are implementations of individual elements that support open innovation in state policy, but none explicitly utilize the OI framework.	Bidirectional collaboration
Bergman (2010)	Organization-level	The 'European paradox': the inability to convert scientific knowledge to commercial utilization.	Commercialization developments within European universities are markedly heterogenous. Firms still seek mainly public science outputs while (most) universities focus on increasing commercialization. This drive however has led to increasing opposition from the academics toward the commercialization of science.	Bidirectional collaboration
Penin (2010)	Individual-level	Consequences of academic patenting	Patenting university research may facilitate technology transfer, but delays publication and thus hinders dissemination of scientific knowledge	University as knowledge supplier
Ebner, Leimeister & Krcmar (2009)	Organization-level	Developing a framework for 'Community Engineering for Innovation' as concept for IT-supported idea competitions utilizing virtual crowds.	Idea competitions should focus on generation of ideas, address broad topics, include attractive incentives and involve all stakeholders early on. Communities, not implementation, are key to success.	Bidirectional collaboration
Levy, Roux & Wolff (2009)	Organization-level	Are there distinct collaborative patterns in UIC? Are they related to firm characteristics?	Typology of four collaboration logics and patterns, discriminated by frequency of interaction and level of secrecy (partner count). Linking firm size, sector and proximity to collaborative behaviour.	Bidirectional collaboration
Markman, Siegel & Wright (2008)	Multiple levels	Review on research and technology commercialization research and identification of research gaps	Proposing a taxonomy of modes of commercialization: Internal, quasi-internal (incl. incubators and intermediaries) and externalization approaches.	Bidirectional collaboration
West (2008)	Technology-level	How is open science commercialized without explicit IPR (i.e. patents)?	'Open' science should be defined by the availability, flows and ability to apply forms of tacit and explicit knowledge. Excludability may originate from tacit knowledge and not only IPR. Introduction of notion of open science commercialization process.	Bidirectional collaboration
Young, Hewitt-Dundas & Roper (2008)	Organization-level	How do different IP management practices at public research centers influence potential knowledge spillovers	University- and company-based public research centers have different IP strategies, with university-based ones focusing on generation of public good, and company-based seek to generate	Dual role of universities as suppliers and exploiters of (codified)

			competitive advantage with organizational characteristics influencing spill-over types.	knowledge
Tether & Tajar (2008)	Organization-level	Extending UIC research to cover other public science base and private research organisations and to include also service firms.	Specialist knowledge providers (SKP) complement firms own innovative activities and different types of SKP complement each other; Importance of networking and social capital; service firms employ universities less.	University as knowledge supplier; private research organizations act as intermediaries.
Fabrizio & Di Minin (2008)	Individual-level	Relationship between patenting and publishing research	Publication and patenting are complementary instead of substitutes, although quality of publications may decrease over the long run	University as knowledge supplier
Wright (2008)	Organization-level	How can relationships between firms and universities be best managed? How can divergent organizational goals of firms and universities be reconciled to enable collaboration?	Three issues lead to more successful collaboration: 1) Long-term partnerships favoured over transactional approaches; 2) High involvement of senior management; 3) Involving universities on a strategic level, not only on isolated (technical) problems	Bidirectional collaboration
Allison & Eversole (2008)	Policy-level	How should universities engage with the regional innovation systems?	Place-based knowledge generation and open innovation open new possibilities for embedding universities to their local regions and act as catalysts and intermediaries for the benefit of regional innovation systems.	University as regional innovation catalyst
Perkmann & Walsh (2007)	Firm- / Policy-level	Importance and role of university-industry relationships (versus other U-I links)	University-industry relationships are both widespread and important in driving innovativeness of firms; open innovation implies relational forms of collaboration	Bidirectional collaboration
Siegel & Wright (2007)	Policy-level	Effects of technology transfer by codified IP and resulting policy implications.	Performance of science-based spin-offs that rely on commercializing university or PRO research is disappointing.	University as knowledge supplier
Lam (2007)	Organization-level	What types of career models can best support university-industry collaboration and knowledge flows?	Extending Internal Labour Markets to cross-boundary settings between firm and university enable efficient knowledge flows and flexibility to innovate.	Bidirectional collaboration; University as broker / hub of knowledge assets
Gittelman (2007)	Team-level	Does geographical proximity influence likelihood of scientific knowledge or technology creation?	In science-based teams high distance collaborations lead to more scientific collaboration and local collaborations to patentable knowledge.	Bidirectional collaboration
Hershberg, Nabeshima & Yusuf (2007)	Policy-level	How should Asian countries involve universities best in their innovation systems and policies?	Previously Asian universities have mainly focused on educating specialized skills to workforce and now they are increasingly building university-industry linkages	University as knowledge supplier / actor in a cluster
Agrawal (2006)	Transaction-level	Why are some firms more successful than others in commercializing university-licensed knowledge?	Engaging the inventor add to the likelihood and degree of commercialization success.	University as knowledge supplier
Laursen &	Organization-	Influence of search strat-	Firms with “open” search strategies	University as

Salter (2004)	level	egy (openness), size, age and R&D intensity on propensityof manufacturing firms to collaborate with universities	(using a wide variety of external knowledge source types) are more likely to collaborate with universities. Size and R&D intensity also increase chance of collaboration.	knowledge supplier

Collaboration Between Finnish SMEs And Universities Of Applied Sciences: Results Of A Large Survey

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Abstract
Finnish universities of applied sciences (UASs) have been challenged to establish and maintain cooperation with the heterogeneous group of small and medium-sized enterprises (SMEs). In order to assess the present amount and type of their cooperation and to understand the degree of satisfaction with the current cooperation and the potential possibilities for new cooperation, a survey was conducted by the UASs and the Federation of Finnish Enterprises. This paper aims to study the following three dimensions: the amount of cooperation between SMEs and UASs, the experience gained and the SMEs view of the regional impact of UASs. A web-based poll was sent to members of the Federation of Finnish Enterprises. The questionnaire consisted of 22 structured questions. The data was analysed quantitatively, and the results are presented with the help of descriptive statistics (frequencies, percentages). Statistical analysis was performed using SPSS and a priori P-value of < 0.05 was selected to indicate the statistical significance. A total of 1,488 entrepreneurs answered the survey. Almost half of the respondents (41.5%) represented micro-companies with 2-5 employees. More than half of the respondents represented companies which were over 10 years old.

The results show that the UASs have a positive impact on regional competitiveness, employment and entrepreneurship. In addition, the UASs strengthened the regional appeal and improved recognition and development of the business sector in the region. Compared to the respondents of small companies, micro-companies and sole entrepreneurs, the respondents from medium-sized companies held the most positive view about universities of applied sciences. Furthermore, the medium-sized companies also had more experience and a larger variety of cooperation with UASs.

The results indicate the challenge in developing cooperation with sole entrepreneurs, micro-companies and small companies. Also there is a challenge in developing cooperation to the level of partnership; that was the most appreciated mode of cooperation, but the companies had only limited experience in different forms of partnership with UASs.

Keywords
Collaboration, SMEs, UAS, Regional impact.

1 Introduction

Finnish universities of applied sciences (UASs) have been challenged to tighten their cooperation with small and medium-sized enterprises (SMEs). In this introductory part, we describe the present situation of cooperation between UASs and companies and its challenges according to the literature.

UASs are described as “multi-field regional institutions focusing on contacts with working life and on regional development” (Ministry of Education and Culture 2013; Ministry of Education and Culture & Ministry of Employment and the Economy 2012; Ministry of Education 2011). This kind of spirit of regional UASs has its origins in the Finnish law for universities of applied sciences dating from 2003 (Statute 2003). According to this law, UASs are expected to conduct research and development related to local and regional enterprises according to their needs.

In the writings of the Finnish National Innovation System, UASs are seen as potential partners for SMEs (Mora 2010; Research and Innovation Council 2010; Maassen 2012). UASs define their research and development work as applied and development-oriented research. The challenge of tightening cooperation with the SMEs can also be seen in the proposed future law for UASs' finance: the draft states that “the goal is to strengthen the regional development and cooperation between UASs and SMEs”. (The law is in the process of the Finnish Parliament.)

There are expected to be benefits for both parties from tighter cooperation. Cooperation would enable companies to use the knowledge and competence of multi-field UASs working as partners with the SMEs in the development or innovation work. For UASs it provides the possibility for competence- and practice-based education and carrying out applied research.

The heterogeneous group of SMEs is a challenging companion for higher education institutions. Companies vary by their size, business, business-area, knowledge, skills, and orientation for future and capacity for developing their business. In Finland, there were 322,232 operating enterprises in 2011 (Business Register of Statistics Finland 2012). Small or medium-sized enterprises, i.e. enterprises with personnel fewer than 250 people, represented 99.8% of all enterprises.

The networks of universities of applied sciences and the Federation of Finnish Enterprises had discussed the problematic, from the viewpoint of SMEs, of lacking knowledge on the impact of UASs. The issue has been evaluated through other viewpoints.

For example, there was a survey made of UAS graduates (N = 5,405) in Finland (Laitinen-Väänänen & Vanhanen-Nuutinen 2011), which showed that the cooperation between workplaces and UASs is mainly based on traditional study processes, e.g. student internships and a theses. In addition, research and development (R&D) work as a content of cooperation was seldom mentioned. There was a large survey study also on the nature and practice of research and development done in the UAS sector (Marttila et al. 2004; Marttila et al. 2007.). National evaluations have also been carried out on the impacts of research, development and innovation (Maassen 2012; Maassen 2011) and about the regional impact of the UAS sector (Käyhkö et al. 2006).

In order to tighten the cooperation, more knowledge and deeper understanding on the cooperation and the SMEs' needs was required. To assess the current extent and type of cooperation from the SMEs' point of view and to understand the degree of satisfaction with that and the potential possibilities for new cooperation, a network of universities of applied sciences and the Federation of Finnish Enterprises conducted a survey in the autumn of 2012 among the member entrepreneurs of the federation.

The purpose of this study was to find out what kind of cooperation entrepreneurs had with UASs and whether that cooperation has regional impact from the perspective of entrepreneurs. The research questions were the following:

(1) What kind of cooperation do the entrepreneurs have with the UASs?

(2) What do the entrepreneurs regard as the benefits of the cooperation from the viewpoint of the companies?

(3) What kind of regional impact do the UASs have from the viewpoint of the companies?

In this paper, we focus on three dimensions of the study:

(1) The extent of cooperation between SMEs and UASs

(2) SMEs` experience of the cooperation and

(3) SMEs`view on the regional impact of UASs.

This paper proceeds by describing the data and the analysis of the study. We will then describe the main results according to the research questions set in the introduction. This is followed by the section of conclusions and recommendations.

2 Methods

2.1 The data and analysis

A web-based poll was sent to the members of the Federation of Finnish Enterprises, which has approximately 116,000 members and represents almost one-third of the operating enterprises.

The survey was planned and executed in cooperation with researchers and the Federation of Entrepreneurs. The group of respondents was selected by a random sample. The randomness was verified subsequently. An invitation and link to the survey was sent by email to 34,000 entrepreneurs, of whom 4,000 were Swedish-speaking and 30,000 Finnish-speaking. The questionnaire consisted of 22 structured questions.

The data was analysed quantitatively. The results are presented with the help of descriptive statistics (frequencies and percentages). Statistical analysis was performed using SPSS and a priori P-value of < 0.05 was selected to indicate the statistical significance in the application of a variance analysis and the Tukey test. Non-informative answers were excluded when applying the variance analysis. In addition, some questions were analysed by cross-tabulation and with the chi-square test. The respondents were divided into four categories: sole entrepreneurs, micro-enterprises (less than 10 employees), small enterprises (less than 50 employees) and medium-sized enterprises (50-249 employees). Large enterprises (more than 249 employees) were combined with medium-sized enterprises.

3 Results

3.1 Responding entrepreneurs

A total of 1,488 entrepreneurs responded to the survey. From the respondents, 37.5% (N = 558) were female and 62.5% male (N = 930). Almost all were Finnish-speaking (94.9%). More than half of the respondents represented micro-enterprises (55.8%). The second largest group were sole entrepreneurs (21.7%), while small enterprises accounted less than 20% (19.0%) of the total. Less than 4% represented medium-sized enterprises (3.3%). Only three of the respondents had a large company.

Gender correlated significantly to the size of the enterprises (Chi2 test, p<0.001). Women formed the majority of sole entrepreneurs.

Around half of the respondents represented sectors like industry (10.5%), construction (9.7%), social and health care (9.5%), wholesale and retail (10.8%) and other service sectors (11.8%). The rest (48.1%) of the respondents came from various sectors, but the amounts of each sector were so small that they were combined into a group of “others sectors” (Figure1). In the analysis of regional aspect, most of the respondents were from the metropolitan area of Helsinki (15%). However, the enterprise locations did not correlate to the enterprise sizes (P=0.266)

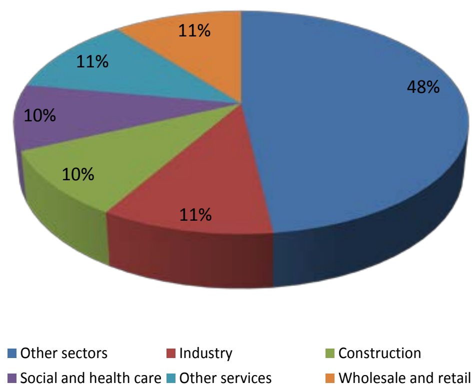

Figure 1. Respondents’ sectors.

3.2 Forms of cooperation

More than 55% (56.2%) of the entrepreneurs had experience of cooperation with UASs. Most of their cooperation related to students' processes (53%) and least on partnership

(4%). (Figure 2). When analysing the company size and the forms of cooperation, the study indicated that every form of cooperation was more typical for bigger companies and less typical for sole entrepreneurs.

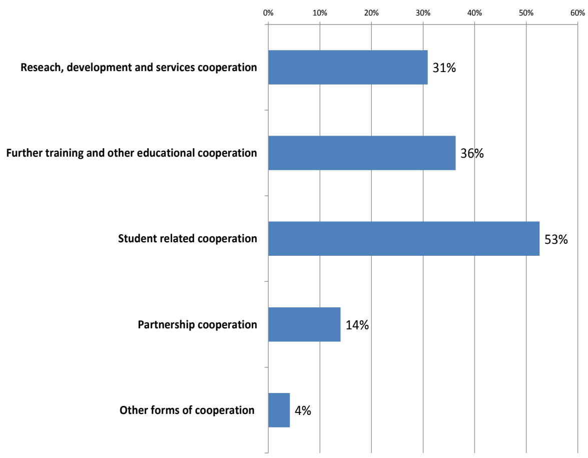

Figure 2. Forms of cooperation.

There was a significant difference between the respondents' business sectors in cooperation related to R&D experience (Chi2-test, P=0.002), partnership experience (chi2-test, P<0.001), and in further training and other educational cooperation experience (chi2-test, P<0.001). In student-related cooperation, there was no significant difference between the business sectors. The social and health care sector respondents claimed to own a variety of experience in cooperation.

Company size seemed to correlate positively with the amount of student-centred cooperation entrepreneurs had with the UASs. Of small enterprises, 32% stated that they cooperate with UAS students while of medium-sized company entrepreneurs almost all (94%) did so. Student-centred cooperation was typically related to internships and theses.

Partnership cooperation was defined in the survey by describing actions where the company's representative acts as a mentor or alumni at the UAS or where the company and the UAS carry out joint marketing or there is a partnership contract between the company and the UAS or the company representative acts as a member in the UAS administration or joint committee, or vice versa. The smaller the company was, the less experience it had about partnership cooperation with the UASs. This result is linear with the other cooperation forms in the study. The results show that most of the partnership cooperation had become established in medium-sized companies (36.5%). Less than 10% of sole entrepreneurs had experience on partnership cooperation with UASs, and almost 90% of the micro-enterprises did not have partnerships experience with UASs.

3.3 UASs’ regional impact

UASs’ regional impact was measured with the help of the following dimensions:

› provision of information about UAS services and competencies,

› significance of the UAS services to regional competitiveness,

› effects of UASs on regional employment,

› UASs' entrepreneurship promotion in the region,

› significance of UASs to the regional appeal and

› UASs' promotion of development and recognition of the business sector and companies in the region.

The respondents had very positive perception about the UASs’ regional impact. The impact of the UASs to the regional appeal was assessed as being very positive by over 80% of the respondents. About 70% of them thought that UASs had promoted the growth of new entrepreneurship in the region, and 80% had the opinion that the UASs had had a positive impact on employment at the region. The UASs and their services were seen to increase the regional competitiveness (80%). The UASs had also promoted the recognition and development of the business sector and companies within the region, according to almost 50% of the respondents. However, the UASs had not succeeded as well in providing information about their services and competencies. Only 44% of the entrepreneurs held the view that the UASs had informed about their services and competencies sufficiently. (Figure 3)

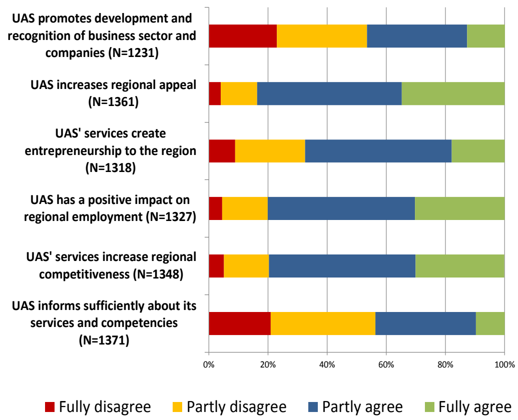

Figure 3. UASs' regional impact

There was a statistically significant association between the size of the company and the entrepreneurs’ view about the UASs’ regional impact. The association was significant for the UASs’ impact on the recognition and the development of the sector and the companies in the region (variance analysis, P=0.010), the regional appeal (variance analysis, P=0.041), the employment in the region (variance analysis, P=0.020), the competitiveness of the region (variance analysis, P= 0.002) and provision of information about the UASs' services and competencies (variance analysis, P=0.001). No significant association (variance analysis, P=0.313) between the size of the company and the image of it was found in the assessment of the impact on entrepreneurship promotion in the region.

The entrepreneurs from medium-sized companies held a more positive view about UASs' impact on the recognition and development of the sector in the region (variance analysis, P=0.010). The views of the entrepreneurs from medium-sized companies differed significantly from those of sole entrepreneurs (Tukey's test: P=0.006) and entrepreneurs from micro-companies (P=0.016). The entrepreneurs from medium-sized companies had also a more positive view about the UASs' impact on regional appeal than small companies, micro-companies and sole entrepreneurs (variance analysis, P=0.041). The result was the same also with the view towards the impact on employment in the region (variance analysis, P=0.020). There was a significant difference between sole entrepreneurs, micro-companies and medium-sized companies (Tukey's test: sole entrepreneurs P=0.047; micro-companies P=0.023). According to the respondents from the medium-sized companies, the UASs had significantly more positive impact on regional competitiveness (variance analysis, P= 0.002) than did sole entrepreneurs or the respondents from micro-companies (Tukey's test: sole entrepreneurs P=0.014; micro-companies P=0.004).

The association was significant also between the size of the company and the entrepreneurs' view of UASs' provision of information about their services and competencies (variance analysis, P=0.001). Sole entrepreneurs held a more positive view on this than entrepreneurs from micro-companies or small companies (Tukey's test: micro-companies P<0.001; small companies P=0.017). Nonetheless, there was no significant association between the views of sole entrepreneurs and entrepreneurs from medium-sized companies.

4 Discussion

The purpose of this study was to investigate the three dimensions of cooperation between SMEs and UASs:

(1) extent of the cooperation between SMEs and UASs

(2) SMEs´ experiences of the cooperation and

(3) SMEs´ views of UASs' regional impact.

4.1 Limitations of the study

The data concerning the respondent group was compared with the data from Statistics Finland on Finnish enterprises and entrepreneurs (Business Register of Statistics Finland 2012). The reference group was chosen from the data of Statistic Finland because the Federation of Finnish Enterprises didn't have all the needed information on their members.

The respondents represented quite well Finnish enterprises as regards the size, the domain and the regional spread out. The variable which affects the generalization of the results is the education of entrepreneurs. It can be stated that the respondents' education level was higher than the corresponding level in the national statistics. This probably affected the positiveness of the respondents' views on cooperation with UASs and their experience of it.

When comparing the respondents' sectors of business to the reference group, it can be stated that the distribution corresponds quite well with that of the reference group. While in the nationwide statistics on enterprises 34% of companies are from the metropolitan area, the study respondents represent more the other parts of Finland. Due to the low number of respondents and differences between the respondents' group and the reference group, this study does not justify a wider generalisation. However, it can give some general premises for the development of further cooperation.

4.2 Cooperation

The results show that the entrepreneurs from medium-sized companies were experienced in cooperation and had a larger variety of ways to cooperate with UASs. Furthermore, the medium-sized companies assessed the usefulness of cooperation more positively than did sole entrepreneurs or entrepreneurs from small companies or micro-companies. The results also indicate the challenge of developing cooperation to the level of partnership, which was the preferred mode of cooperation. Nevertheless, the companies had only limited experience in different forms of partnership with UASs. In addition, partnership requires change in organisational culture: a new paradigm, where interaction and diversity are enabled and where multidisciplinarity, flexibility and sensitivity are found. Real commitment to stakeholders is more than maintaining contacts. It challenges UASes seeking and using ways of engaging in a dialogue with stakeholders. (Jongbloed, et al 2008.) Also new tools to enhance cooperative activities are needed. Partnership also embraces various forms of implementation: formal, informal, horizontal and vertical. (e.g. Häggman-Laitila & Rekola 2011 a,b).

4.3 Regional impact

According to the results of this research, the UASs have succeeded in building their role as significant regional actors. However, there are challenges in providing information about UAS services and competencies and about the ways the UASs can promote entrepreneurship in the region. The results show that the UASs have a positive impact on regional appeal, competitiveness and employment. The UASs have also succeeded in promoting recognition and development of the regions' business sectors. The medium-sized companies held the most positive view about the regional impact of UASs.

In order to strengthen their participation in regional development and to become proactive actors in the region, UASs need to further develop cooperation with sole entrepreneurs, micro-companies and small companies. This new mode of collaboration can start by finding answers to the following question: What new operations should be created and emphasised and what old operations should be reduced and eliminated (Kim & Mauborgne 2005, 52)? This demands interactive meetings between the UASs and the companies, dialogical communication skills, creation of a mutual language and understanding, joint agreements, participatory change management, and a shared resource (Häggman-Laitila & Rekola 2011a,b).

5 Conclusions

As a conclusion, the results indicate clearly that the bigger the company the more experience and a larger variety of ways to cooperate with UASs it has. Bigger companies had more positive attitudes concerning UASs, and, in addition, they assessed the usefulness of cooperation more positively than smaller companies.

UASs are significant regional actors. So far, cooperation with SMEs is mainly embedded in study programs (e.g. practical studies, project work, internship) and in research and development projects. The current structures and processes in education and cooperation with business do not fully allow responding to the specific challenges of different regional actors. Therefore, new forms of cooperation and partnership need to be developed between UASs and regional companies in order to strengthen UASs' regional impact.

Company size seems to be significantly associated with the content and intensity of cooperation between UASs and companies. Therefore, the UASs should pay attention to this while planning and setting goals for cooperation. Also R&D cooperation should be diversified according to the size of the company.

The study challenges the UAS sector to:

- › increase cooperation with more SMEs
- › know better the partners and their needs and the ways they operate
- › promote informal relationships in addition to formal relationships
- › target their services for companies of different sizes (no elephant-sized services for the needs of mice)
- › communicate and market better the services and competencies of UASs

› develop long-term partnerships with companies, gradually increasing the involvement.

The study also challenges the SMEs to:

› be more active towards UASs and to use their whole potential
› use UASs' competencies as resources
› commit to long-term relationships that facilitate cooperation
› develop also informal relationships with UASs' personnel.

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Companies And Universities Interaction Aiming At Innovation: The Case Of Natura Exploring A Scientific Entrepreneurship Approach

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Abstract
Most companies seek to establish partnerships with external organizations to innovate, particularly through research and development projects. To pursue more effectiveness in these actions, it is necessary that organizations are embedded in an ecosystem favorable for intensive exchange of knowledge and confidence to establish connecting links that generate co-investment and shared results. The objective of this paper is to show how Natura, the largest Brazilian cosmetic company, implemented actions to stimulate the entrepreneurship spirit in scientists to innovate collaboratively. Regarding the methodology, Natura was the object of this case study (Eisnnhardt, 1989; Yin, 2001) based on the 2012 Natura Campus "Call for Proposals". It developed a coaching activity involving researchers from the company and from the universities (around 12 academic people, the Call for Proposals' finalists). The three day face-to-face interaction was designed to engage potential partners, enable an intense exchange of ideas and co-developments in the research project. The results were remarkable, based on the personal experiences of those involved. This report contributes to the actors of the innovation process, highlighting new possible dimensions that can engage potential partners, intra-organization and inter-organizations.

Keywords
Companies and universities interaction, scientific entrepreneurship.

1 Introduction

With the advancement of cooperation in science and technology Research Institutions (RI), governments and companies have sought to implement a broad set of actions in order to raise the effectiveness of this process and reach the more relevant innovations.]

Pioneers in practicing open innovation considering different industries have been opening up their approaches to innovation. Nevertheless in most cases firms are not operating fully on the open innovation mindset integrating and managing their portfolio in place (Mattes, 2011).

In Brazil, with the research and teaching structure built, the National Innovation System can be positioned at an intermediate level. But in the interaction processes, they still lack the people and models to get a faster innovation. The legal framework and collaborative culture needs to move forward. This would include changing how the researchers themselves present opportunities for innovation from their research and how companies are placed to build a shared value proposition. On the one hand the concept of an entrepreneurial university has expanded and on the other hand one question emerges. What can companies do to foster scientific entrepreneurship with the academia?

There are many possibilities to expand the impact of the use of open innovation that are not yet explored. One of the ways to produce this expansion is to create an interaction spaces between people's internal organizations and a network of partners. This would provide results aligned to the corporate innovation process while allowing the full potential, purpose, and expertise of existing outside specialists.

As an extension of this path Natura sought to combine the entrepreneurial attitude to the process of a Call for Research Projects Proposals. The concept adopted involved actions on promotion of a more collaborative culture and training through online and face-to-face coaching. This allowed the identification and selection of high-potential partners to implement projects and overcome initial goals through motivation and personal interaction with the company's researchers.

The objective of this paper is to show how Natura, the largest Brazilian cosmetic company, implemented actions to stimulate the entrepreneurship spirit in scientists to innovate collaboratively. We described pathways adopted to promote interaction among researchers from academia and industry. This is very useful because the relationship dynamics between these innovation actors as well as its management are not fully covered in the literature (Perkmann and Walsh, 2007).

This article is structured according to the following topics: section two highlights the university-industry interaction historical context. Section three approaches how this interaction is going into the Brazilian innovation system. Section four indicates the entrepreneurship and the systemic view as important assets to elevate the quality level of collaboration. The methodology used on this research is mentioned in section five. Section six shows the results describing the case of Natura and finally section seven reports the main final considerations on this matter.

2 Industry and research institutions cooperation: From bilateral relations to an open innovation

The history of collaborations between the public and private sector in the field of technological development is not new. Even in the nineteenth century features such as cooperation were observed in a German system. Later in the twentieth century, the United Kingdom had the "missions advice" in which university departments along with engineers helped expanding industries. However, this fact is accentuated and expands in the United States during the Cold War due to the intensification of R & D efforts aimed in the defense sector. In Japan, major technological cooperation programs were mobilized by the government in favor of rebuilding the country after the Second World War (GUSMÃO, 2002).

Many countries are seeking this type of relationship among the organizations of the national innovation system. It´s defined as a set of all organizations, private and public institutions that interact influencing the process of creation and technology diffusion (FREEMAN, 1992 apud FERREIRA, 2002). Some common objectives are: new spin-offs; trilateral initiatives for economic development based on knowledge and strategic alliances. This would include large and small firms operating in different levels of complementary technology, government laboratories, university laboratories and research groups (Etzkowitz and Leydesdorff, 2000).

The traditional view on this interaction approach shows a separation between institutions of science and technology, business and government cooperating,. However, this is no longer the current reality. The so-called Triple Helix concept points out that, due to the complexity of the innovation process these three agents develop overlapping activities. For example, today's universities perform basic and applied research, as well as many businesses. Funds for research come from both the private sector as well as the public sector.

This interactive model shows that the vision of the actors acting by themselves no longer holds, breaking the linear view of innovation. Nowadays, innovation is more and more related to the collaboration process among the different actors within systems involving multiple stakeholders.

Thinking of innovation as a result of an open process also contributes to the exploitation of opportunities in organizations that are in an external environment. The basic premise of theopen innovation model is that the knowledge created and made available globally, contribute to the development of innovative activities (Chesbrough, 2003).

Within the process of open innovation, collaborative practices are diverse and can be chosen according to stakeholders' needs and contexts of specific opportunities in companies, research institutions, policy incentives and resources available. Mattes (2011) shows twenty possible approaches based on companies cases.

Supplier innovation work-shops	OI intermediaries	Technology Spin-In
Supplier integration	Listening posts/ Technology scouts	VC-based Technology Sourcing
Supplier innovation network	Scientific Advisory Boards	Go-to-market Joint Ventures
High-tech campus	University co-operation Academ-ia/	New value proposition Strategic Alliances
Competitive innovation race	Start-up innovation network	Cross-industry innovation
Supplier in residence	Joint development	Cross-industry and/or cross science innovation hub
Consortium project	Technology In-licensing	

Figure 1: Open Innovation approaches
Source: Authors adapted by Mattes (2011).

These approach types are implemented in different stages of maturity by different industries all over the world even in low intensity. Either through ignorance or viability of the application of the models in different contexts. To better understand the Brazilian context, the next section is dedicated to present their main characteristics.

3 Context of the Brazilian innovation system

Technology management in Brazilian public universities has gained increasing importance within the Brazilian innovation system. The 2004 Innovation Law provides specific legal guidance on intellectual property, technical cooperation and technology transfer, favoring the intensification of these processes.

According to Varrichio et al. (2012), the interaction between the actors is a challenge to be overcome, especially in developing countries, such as Brazil. In the process of improving the relationship among academia, companies and government, it is necessary the existence of means of knowledge transfer between research institutions and companies promoting the dissemination of technology transfer.

An evaluation of the effects of the Innovation Law shows that the national regulatory framework has been highly improved, although adjustments still need to be implemented in order to increment the level of its potential benefits. Projects conducted in partnership among universities, research institutes and companies is growing, although the major challenge relies on the launch of new products/ processes in the marketplace (Torkomian and Santos, 2013)

The main challenge that has been highlighted is the need to increase the scientific content of technologies. Brazil and other countries in a similar development stage have a catching up process as a goal. The interactions between research institutions and companies are even more important. Besides it is necessary to move forward on the maturity of interactions among the innovation actors. Public policies must be institutionally creative to face these challenges (Suzigan and Albuquerque, 2011).

4 Entrepreneurship in the university industry interaction

Bell and Pavitt (1993) mention the importance of the structure of scientific and academic research to the process of technological accumulation achieved by developed countries. In these countries academic research mainly contributed to the training of highly qualified personnel capable of handling the most advanced methodologies and become members of a network of national and international community in specific knowledge areas. Also emphasize the complementarity between firms and research institutions where the latter represent sources of new knowledge that, in turn, are able to generate input advances in the technical base companies.

The university concept applied in the context of its cooperation with the productive sector reflects a process of evolution of the activities performed by these institutions. The research and the interaction of society were not always a central mission of the universities. In order to fully understand cooperation between universities and companies, it is necessary to briefly discuss the role of the university in society. In this sense, the university can work with companies and other institutions of society not only with the function of training qualified personnel, but also with the role of research and extension in the broad sense, enabling different ways to support economic development. Denoting this perspective, the idea has gained strength from an entrepreneurial university as a result of the incorporation of new functions.

The approach of an entrepreneurial attitude in the academia demonstrates significant potential for the generation of more and more knowledge with the potential to produce innovation that can be applied and turned into wealth. Accordingly, to promote a culture of planning applied research projects as well as the co-construction of projects already involving the company's researchers can promote more effectively collaborative research. One of the useful approaches in this process is to promote systemic view between the actors involved.

The context of scientific and technological researchers today requires a systemic view of the innovation process. According to the OECD (2004), a systemic view of innovation highlights the importance of ideas, knowledge, experiences and information that are transferred and diffused among different actors through learning and interaction.

The systemic view is useful to integrate into the entrepreneurship approach because it allows and fosters the upstream innovation processes providing a more complete framework from an industry managers point of view.. It enables us to deal with the elements of a situation in concert rather than in isolation. Its power lies in its simplicity and effectiveness. It offers the potential to find systemic focus in any situation (GARY BARTLETT, 2001) and these facilitating features are very useful when considering on line and face-to-face interaction.

The systemic view is a way of thinking, identifying and assessing the results of our actions more broadly, in terms of time and space. Furthermore, it relies on how to face the reality of valuing interaction, sharing and acting in networks and being aware that our actions have consequences on those who are connected to us.

The systemic view enhances the interaction between the parties, rather than focusing on each one separately. The whole is greater than the sum of the parts due to the synergy which is generated in the interaction. So when there is a relationship between the different actors, the benefits generated tend to be higher than when there is a single action.

Applying these ideas to the field of innovation, researchers must take a broad and holistic view of the entire process, considering possible interactions and outcomes. Moreover, one must take into account the possible environmental variables that can affect the process.

Research activity, based on the systemic view, seeks to identify partners who can contribute to the achievement of goals proposed. And from the point of view of scientific entrepreneurship, a systemic view is the search for potential applications, as well as identifying future markets where such results could benefit our society.

5 Methodological aspects

The field of this research was the social-applied sciences once the object of investigation involved organizations and different aspects of innovation management. The study was carried out at Natura Cosmetics focusing on Natura Campus Call for Proposals 2012. This program is the company´s initiative to promote partnerships between Natura and the scientific community (more about Natura Campus Program at www.naturacampus.com.br/en-US/home).

It developed an exploratory research that followed the phenomenological paradigm (Taylor and Bogdan, 1984) with a qualitative approach. The type of research adopted was an action research (Bryman, 1989) using the case study as strategy of research (Eisnnhardt,1989; Yin, 2001) to elaborate, implement and evaluate a special initiative. This initiative aimed to foster collaboration in networks and arouse the entrepreneurship spirit into the collaboration environment created by the Natura Campus Call for Proposals 2012. The specific steps used on this initiative are described into the Results section.

6 Results - innovation at Natura

Natura is a leading cosmetics, fragrance, and toiletries company that sells through a network of 1.4 million consultants (sales representatives) in Brazil and abroad. Outside of its core Brazilian market, Natura has a presence in Argentina, Bolivia, Chile, Colombia, France, Mexico and Peru. Established in 1969 from the fruit of two passions: cosmetics and relationships. For over forty four years it has sought to create value for society as a whole generating integrated triple-bottom-line (TBL) results - economic, social and environmental. Natura´s TBL strategy and efforts are successfully recognized by international institutions. It was also placed as the eighth most innovative company in the world by Forbes Magazine in 2011.

6.1 Results – Natura Campus Program and Call for Proposals 2012

Natura Campus Program

Natura believes in collaborating with networks of innovation as a strategy to build the future. The Natura Campus Program was created for purposes of awarding feasibility to this rationale of linking Natura innovation networks with the scientific community.

The focus of this article is to share the case of the 2012 Natura Campus Call for Proposals. The main goal of this call was to allow Natura to receive and evaluate science, technology and innovation research project proposals that are meant to be executed in partnerships between Natura and public or private institutions.

To implement this Call, two public notices were built: the Amazon Notice and the Science, Technology and Innovation Notice. Each of them were conceived with different objectives according to the research areas addressed.

It is important to highlight that the Amazon Notice has been developed separately due to the special context of the company. During the call for proposals, a new innovation center was launched: "Nucleo de Inovação Natura Amazônia" - NINA. The center was born to be an advanced hub for partnerships which should articulate the regional system of innovation. On this sense, the Amazon Notice was established to be the main technology scout in 2012 to provide new joint research projects, which quickly resulted in a new portfolio. Furthermore, to receive projects by the institutions from other regions including internationally, the second public notice was launched.

The table below summarizes the main characteristics of each public notice:

	Science, Technology and Innovation Notice	*Amazon Notice*
Goals	a) To foster the innovation strategy with new ideas, projects and the strengthening of inno-vation networks; (b)To stimulate scientific entrepreneurship through collaboration in science, technology and innovation; c) To promote partnerships to develop and acquire competences for the parties involved	(a)To leverage the opportunity for collaboration and innovation in the Amazon region; (b)To propel Natura's open innovation and network strategy in the Amazon region; (c)To foster the innovation strategy with new ideas, projects and the strengthening of innovation networks; (d)To promote partnerships for capacity-building and capacity-development, enabling research networks to be formed within the Amazon region;
Themes of interest	_Traditional and advanced skin and hair sciences; _Sustainable Technologies; _Wellness and relationship sciences; _Senses, Design and Experiences _ Networking and Open Innovation	_Culture and Society; _Preservation and Biodiversity; _Forests and Agriculture; _Product and Process Design.
Target audience	University, Research institutionss and com-panies researchers from all over the world	University, Research institutions and companies re-searchers from all over the world but the leadership should be by an Amazon organization

Table 1. Guidelines summary of the Call for Proposals 2012
Source: Authors

There were no limits for the budget requested and the projects should take no more than 36 months. To guarantee the wide dissemination of the initiative, there were many presentations and workshops in RI in Brasil and worldwide. Furthermore, videos were produced (available at http://www.youtube.com/watch?v=OlRpGSP22iE), to enhance the interaction in the social networks, such as Facebook and Twitter. An internet video conference was conducted to launch the Call, not to mention the spontaneous online and printed media. The submission phase was from August 15th to October 22nd, 2012, but its dissemination started in April of the same year.

During the dissemination process, one of the most stressed points was the opportunity to co-develop a great idea. Natura was not willing only to finance research projects; it was willing to do it together, to foster the research network and to develop shared values with the selected partners. The evaluation process involved different phases and criteria which were elaborated by the internal researchers and managers considering bench-marks on this matter. The first three phases were eliminatory and the scores obtained were registered and accounted to get the final scores at the end of the process. The phases and features were developed based on the Natura internal innovation process. It includes the project alignment to the Natura innovation strategy, the technical merit and a final presentation to the Natura innovation board.

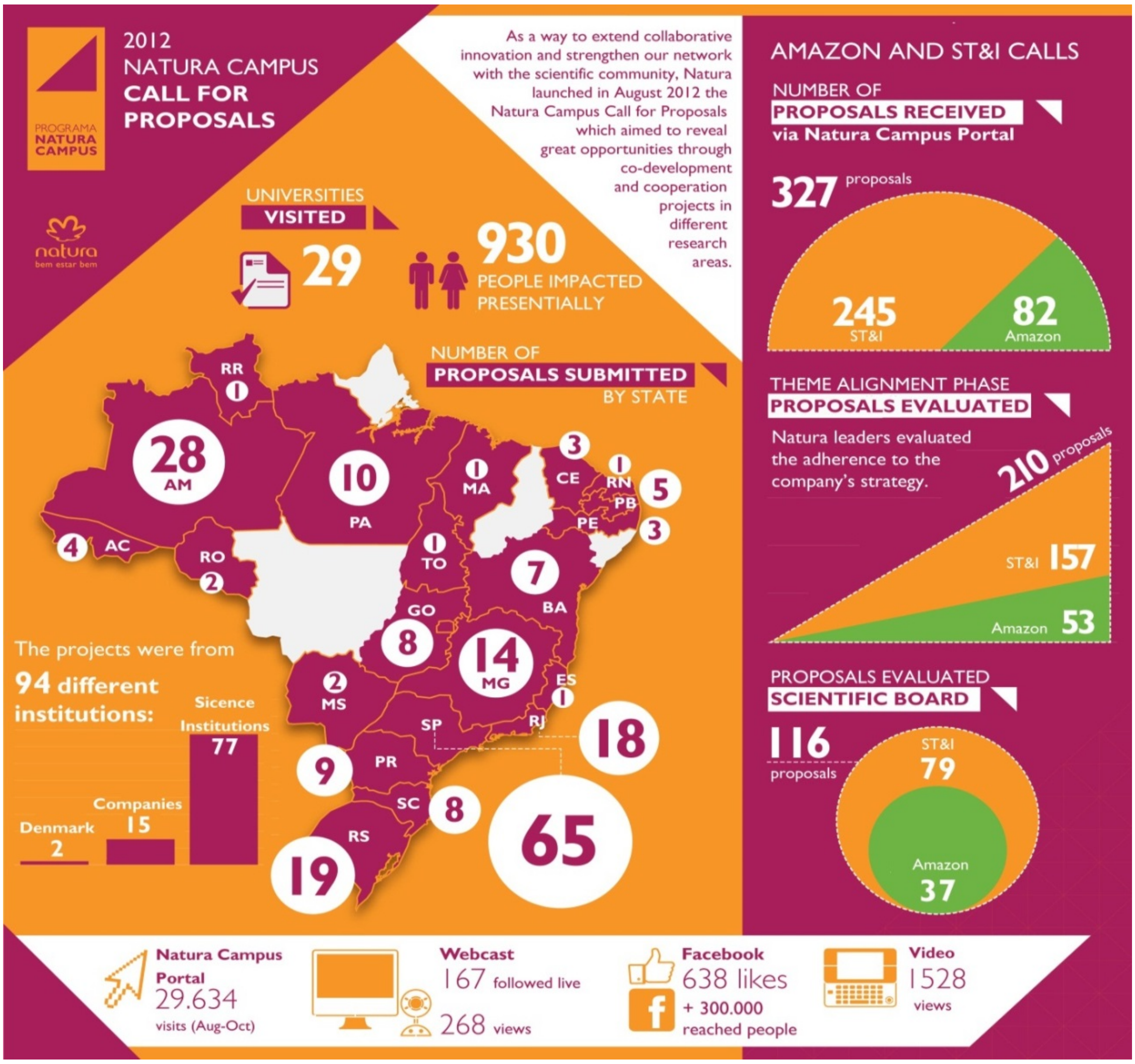

Figure 1. Main results of the Natura Campus Call for Proposals 2012.
Source: Authors

Below we highlight the main results found, also considering perceptions that emerged during the process that involved the direct interaction between the company's researchers and research institutions.

There were 327 proposals submitted, a number that reflected a very high level of interest from the scientific community to collaborate with Natura. References for this type of initiative points to an average of 50 to 100 proposals submitted.

The capillarity observed from the origin of the participants was evident once the projects were submitted by 94 different institutions from 24 different Brazilian states, as well as proposals from Denmark. This demonstrates the effectiveness of the dissemination promoted especially when it is noted that the regions of greatest focus were exactly the ones that stood out in submissions, namely the states of Amazonas – 28 proposals - and Sao Paulo – 64 proposals.

These two results point to a good grip of the dissemination process that was conducted personally in 29 institutions. Qualitatively, it was observed that the face-to-face interaction represented a major differential, with a greater involvement of stakeholders, assertiveness in the proposals content and the increased confidence.

Note that for the Amazon announcement was established a differentiated strategy on the content of the workshops. We selected four target institutions and structured meetings between researchers and institutions with Natura pre-survey work portfolio of projects and skills in order to generate an greater clarity in collaborative initiatives with the greatest potential of innovation. It involved 221 researchers and 74 research lines were mapped. From 58 presentations in these workshops, there were 54 projects submitted to the Call. This experiment showed that a deeper interaction concerning the research areas and clarifying the objectives of the initiatives encourages the participation and increases the assertiveness of the proposed company. At the end, 06 proposals were approved involving several partners and more than US$1,5 million dollars to be invested in the local universities.

Online media was relevant to extend the range of opportunities and support the monitoring process to interested researchers. Access to the website of the Natura Campus reached the milestone of 29,634 hits in a period of 3 months with an average access time of 3 minutes and 22 seconds indicating quality of the visits on the website. This was a result of access to the Natura Campus scientific blogs. Founded on the four major research areas of Natura they provided subsidies in understanding opportunities to partnering with Natura, converging to a significant number of proposals with high adhesion to the needs of the company, about 90 proposals.

With a focus on promoting scientific entrepreneurship, it developed a process of online coaching in partnership with Endeavor, a nonprofit organization specializend on this issue. This phase had the participation of about 80 people, since it was not mandatory. The content of the training allowed the researchers to reflect on the deeper purpose of their research project linking the objectives of the Call for Projects. It encouraged collaboration and a systemic view includinga wider vision and the subsequent steps required to enable new products and services from the science.

At the end of technical merit analysis, Natura invited the 12 best evaluated projects finalists inviting them to move forward on the process getting into a face-to-face process. The finalists had to prepare an executive and technical presentation at the last evaluation phase. Natura was responsible for all expenses involved in this phase (transportation, hotel and meals). The phase of face-to-face coaching was the biggest highlight on the results observed, especially considering the perception of many benefits of the process, including:

› High openness of internal and external researchers to discuss the project and its possible ;

- Evaluation of the participants about personal growth and fostering opportunities in science and technology;
- Valuation of collaboration between participants and interest in knowing the projects and expertise of the other researchers. Strong evidence observed reports the merger of two projects in one more robust involving two universities and a company;
- Improvement of the projects and their presentations to the Executive Board for the final evaluation.

This coaching was built to inspire and provoke the participants on fields such as: how to present an idea to a potential partner; how to perceive the shared value; how to co-create the ideal project, considering the diversity of interests. Also, it had the objective to prepare them to the final phase: the project presentation to Natura´s innovation board.

According to the participants' experience, this coaching process allowed the construction of confidence and the perception of shared value between the researchers from academia and industry. Specially in the face-to-face coaching, the researchers were able to identify the different points of view and to develop a joint proposal that covered the necessities from all people involved.

The participants were in contact with methodologies used by start-ups, such as the pitch presentation and the canvas model. Aware of these tools, the finalists, together with Natura's researchers, started to re-think their projects. Besides the unquestionably technical excellence, they re-organized their presentations, highlighting the objectives and the positive effects – essential points to the evaluation of an innovative project - instead of the state of the art and the methods chosen, already analyzed in the firsts steps of the evaluation process.

The Naturas' researchers affirmed that this process allowed them to better analyze the proposals. They were used to only read the projects to evaluate their relevance. In the Call for Proposals, not only the capacitation, but the opportunity to meet the research leaders and talk about their motivations, the projects context and the researchers involved permitted a rich exchange, exploring questions and developments that weren't possible in a traditional evaluation process. It was observed that some projects that were not well evaluated during the previous phases, were the chosen as in the most innovative ones by the innovation board.

7 Final remarks

Facing the challenges discussed by Suzigan and Albuquerque (2011) where they affirm that the institutions must be creative to move over the barriers set for interactions among the innovation actors. This paper presented innovative tools that companies can handle in order to get results from collaborative networks and consequently collaborate to the interactions set in innovation systems.

Testing new purposes of interactions methods, Natura experienced a promising way to companies and universities to work together focusing on innovation.

Natura learned that more than setting an open innovation platform it is necessary to promote relationships. Natura Campus Program performed efficiently as an open innovation platform not because of its on line structure that is observed in a lot of companies but due to its focus on promoting spaces for interaction (on-line and off-line). Different from the traditional models of Calls for Proposals, Natura Campus Program structured a strategy based on relationships which showed the importance of confidence in the process. This process involved co-organized events in science institutions using pre-work related to that had their technology competences mapped for the internal team to activate the interest of researchers than structuring an on-line space to provide a better alignment to the results of the proposals.

One aspect that should be highlighted on Natura Campus Call approach was the capacity to set an interactive environment to communicate the interests of the company as well as to recognize the partners' ideals and objectives. Besides this aspect the central role of the whole process was to increase the experience of interaction. Thus Natura Campus developed special tools as interactive forms, on line coaching performed by specialized consultants on entrepreneurship and a two day meeting with the finalists for interaction with the Natura´s researchers.

The participants reported an amazing experience on face-to-face interaction positioning this phase as unique opportunity to get a better understanding on how to employ an entrepreneur mind set to structure innovation projects collaboratively. Furthermore we noticed a higher level on the proposals quality when compared to other open innovation initiatives performed by Natura without this collaborative approach.

This compromise with relationship and care about the partner´s networks, much more than a respect posture, it is a strategic choice of the company to keep close future opportunities aligned to Natura´s business. More than a benefit to Natura´s innovation strategy it impacted positively the innovation system through the foster a collaborative culture and the development of business skills in the scientific community, introducing to the external and internal researchers systemic thinking principles and practices besides the entrepreneur attitude.

Finally, this initiative successfully affirms that the innovative model set for Natura to promote companies and universities interaction based on collaboration and relationship brings superior results improving the value of the open innovation process. The future studies could focus on develop a framework and indicators to analyze the interaction process in different contexts and how could the innovation actors implement spaces of interaction looking for emerging innovation opportunities.

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University Regulation And University-Industry Interaction: A Performance Analysis Of Italian Academic Departments

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Abstract

Governments in several countries are putting increasing pressure on universities to encourage applied research activity, intensify their interaction with industry and attract funding from the private sector, in a context characterised by public spending reviews and research funding shortages. The economic literature has provided rich evidence about the institutional factors and individual-level characteristics that concur to influence university involvement in knowledge transfer activities. The aim of this paper is to investigate the impact of academic internal regulations of knowledge transfer activities on the institutional capability to raise funding from industry. Based on extensive department-level data on university funding and university regulation for knowledge transfer in Italy, we address the characteristics of institutional knowledge transfer practices and investigate how they influence the intensity of industry funding to universities.

Keywords

University regulation; University-Industry Interaction; Third mission.

1 Introduction

One of the key institutional challenges governments face in their efforts to support firms' innovation activity is easing the process of technology and, more broadly, knowledge transfer from research institutions to businesses (OECD, 2003).

Although universities have long been involved in so-called 'third-mission' activities (Geuna and Muscio, 2009), a deeper connection between university and industry is nowadays seen as essential for the purpose of technological progress and economic development. A growing pressure is therefore put on universities to produce research that is valuable for industry and to intensify their interaction with agents outside the "ivory tower". The expectation is that universities should not only produce new knowledge, but that this knowledge should be related to established social and economic targets (Laredo, 2007).

There is now substantial agreement in the economic literature that governments should put in place all the necessary measures to ease and promote university-industry collaboration, thereby helping to bring the results of academic research to market. Several empirical works have investigated the drivers of university-industry collaborations and business funding to universities. Particular importance has been recently gained in the scientific literature by academic consultancies and research to order activities, which are identified as very effective informal channels of knowledge transfer. Their highly relational nature amplificates the possible spillovers (Jensen et al, 2010) and activates learning by interacting effects (Perkmann and Walsh, 2008).

At the same time, public budget constraints are pushing several European country governments to apply increasing pressure on universities to raise research funding from industry and to modernize their managerial and organizational skills (European Commission, 2008). As Geuna (1999) notes, since the early 1980s European governments have been intervening more directly in terms of guiding national research systems. This intervention has taken different forms in different countries, but is being driven by similar overall targets, which are promoting a contractual-oriented approach to university research funding, aimed at indirect control of the behaviour of universities through the introduction of (quasi-market) financial incentive schemes. These policies are meant to improve the efficiency of research funds and increase the accountability of universities as well as the pressure to reduce their costs, this latter objective being crucial in view of the constraints on public budgets resulting from the enforcement of the Maastricht criteria (see also Sörlin, 2007).

The Italian university system has long been based on a fully public and highly centralized governance structure, with low autonomy at the university level and a key role played by the state (Capano, 2000). Despite the slow emergence of initiatives to support knowledge transfer in Italy (Muscio and Orsenigo, 2010), the political pressure to commercialize the results of academic research has increased, prompting several universities to develop plans to support the commercial exploitation of scientific research. By 2000-05 the majority of Italian universities had Technology Transfer Offices (TTO) and an internal regulation for revenue-sharing and IPR management. Moreover, universities have been encouraged to regulate knowledge transfer activities adopting firm rules in research contracts and consultancy extra-mural activity. The majority of academic institutions in the country now has a so-called “regolamento contoterzi”, regulating in different ways and to different extents revenues and cost distribution, extension of staff involvement and IPR attribution.

There is a number of institutional and university-level factors that - together with demand conditions and individual-level characteristics - may drive university involvement in knowledge transfer activities (Baldini et al. 2007). For instance, institutional factors such as legislation in favour of knowledge transfer and distribution of intellectual property rights may influence the intensity of university-industry interaction as well as the provision of government funding. Similarly, university-level factors such as provision of incentives to academics, a favourable/competitive environment with respect to inventiveness and commercialization and the implementation of support measures in favour of knowledge transfer may all contribute to this purpose.

Yet we know very little about the impact of university policies and governance systems in areas such as revenue-sharing and IPR distribution on the intensity of knowledge transfer. In principle, aiding the transfer and commercialization of discoveries is in the interests of both inventors and society—the ultimate aim of applied scientific research being to improve the human condition (Litan et al. 2007). Recent empirical evidence provided by Caldera and Debande (2010) shows that university rules on conflicts of interest between academic teaching responsibilities and external activities have a positive and significant impact on university performance in R&D contracts, licenses or spin-off creation. Moreover, universities' royalty sharing policy strongly affects licensing income and granting a higher share of licensing royalties to the inventor stimulates licensing activities. According to this, the aim of this paper is to investigate the impact of academic management practices and internal regulations of knowledge transfer activities on their capability to raise funding from industry through consultancies and research to order. Based on extensive data on university funding and university regulation in Italy, we address the characteristics of institutional knowledge transfer practices and investigate how internal governance and regulations influence the intensity of industry funding to universities.

2 University performance in knowledge transfer

2.1 The determinants of knowledge transfer

Scientific and technological knowledge are seen increasingly as important sources of competitiveness (Muscio and Pozzali, 2012). There is ample empirical evidence attesting to the complexity and diversity of university knowledge transfer activities (D'Este and Patel, 2007). There is also ample evidence in the economic literature about the key drivers of university performance in knowledge transfer. Based on the existing empirical works, we can classify the main determinants into the following categories: geographical proximity between academic institutions and firms, academic research performance and other university characteristics, sources of university funding, university governance and practices, including knowledge transfer intermediation.

First of all, there is one important precondition determining the intensity of knowledge transfer activities, which is proximity. There is a large body of empirical literature on the importance of geography to the innovation process in enabling good interpersonal relationships and face-to-face contacts (Zucker et al., 1994; Almeida and Kogut, 1999; Singh, 2005). Based on the positive experience of high-tech clusters, regional studies have highlighted that territorial agglomeration provides the best context for an innovation based learning economy that promotes localized learning and endogenous regional economic development (Asheim and Isaksen, 2002). Universities directly affect the stock of intangible assets within a region: their research activity has a positive influence on the regional distribution of patenting activity and is a source of relevant knowledge for the firms located in the same region as the university conducting the research (Del Barrio-Castro and Garcia-Quevedo, 2005). It follows that university proximity to firms and regional demand conditions for technology could have an important effect on university knowledge transfer activity, and determine the intensity of university–industry interactions (D'Este and Iammarino, 2010; Muscio and Nardone, 2012).

Secondly, there is evidence that academic research performance influences interaction with industry and that production of high quality research is a necessary condition for knowledge transfer. Innovative firms favour research produced by high quality research universities, which has been published in peer-reviewed journals (Bruno and Orsenigo, 2003; Pavitt, 2001; Hicks et al., 2000). Mansfield (1995) provides evidence that the higher is the quality of the university research and the closer the university is to the innovating companies, the greater will be the academic contribution to industrial innovation. D'Este and Iammarino (2010) and Muscio (2012) find that the higher the quality of the department the more likely it will attract distant business partners. The positive relationship between research performance and university knowledge transfer is confirmed by Muscio et al. (2012), who provide evidence that departments that achieve higher scores in research evaluation exercises are able to attract higher levels of private funding in the form of contract research agreements. Finally, Chukumba and Jensen (2005) find that universities producing higher quality research generate more licenses and higher licensing income.

Several works analyze the effects of institutional characteristics on university–industry collaboration and knowledge transfer. A number of recent empirical studies have found that the size of the university is positively related to the amount of technology transfer (Belenzon and Schankerman, 2009). Academic institutions need a critical mass of researchers in order to improve their chances of interacting with firms (Bruno and Orsenigo, 2003; Landry et al., 2007) or engaging in spin-off creation (O'Shea et al., 2005). Von Tunzelmann et al. (2003) suggest that the capacity for collecting private research funding increases with the share of researchers involved in the research activities, confirming that departments need to develop critical mass in research in order to attract businesses. Institutions with larger numbers of research staff are likely to benefit from greater visibility, greater specialization of departmental research, and more efficient procedures for the establishment and management of collaborations (Muscio and Nardone, 2012).

A new stream of literature has focused on the impact of government funding on knowledge transfer. The creation of new channels of university–industry collaboration has gained strategic relevance to universities primarily because of their potential as sources of external funding (Cohen et al., 1998). The question has been raised whether private and public funding to universities complement or substitute each other. According to a recent OECD review on university funding (OECD, 2010), European universities are primarily funded by the state. Resource allocation mechanisms for public funds are an essential element of reforms of university systems in several countries since governments are applying increasing pressure for universities to raise research funding from industry and to contribute actively to industrial innovation (Arnold et al., 2006; Geuna, 1999). The existence of a form of complementarity between public and external funding to universities would imply that universities need government funding to increase collaboration with industry and their external fundraising options (Mansfield, 1995; Cohen et al., 1998; Perkmann and Walsh, 2008; Jensen et al., 2010; Dechenaux et al., 2011). Several authors have addressed the issue of the positive direct and indirect effects of public R&D on private R&D in academia (Blume-Kohout et al., 2009; Connolly, 1997; David and Hall, 2000; Jensen et al., 2010). Muscio et al. (2013) provide empirical evidence that public funding to universities complements private sources of funding provided via research contracts and consultancies.

2.2 The role of university governance

(1) The governance of institutionalized knowledge transfer activities in universities

The possible effects of university governance of knowledge transfer on frequency and intensity of interactions are difficult to capture and less understood. University governance refers to all strategic decisions taken at the institutional level that aim to promote and regulate knowledge transfer activity as well as motivating faculty members to engage in interactions with industry. The nature of this engagement can be very diverse, ranging from the involvement in collaborative research agreements to carrying out research contracts or consultancy activity (see: D'Este and Patel, 2007; Muscio, 2010). To what extent such interactions are stimulated effectively depends on the proactive approach taken (or not) in establishing favourable conditions in encouraging university-industry interaction and therefore knowledge transfer.

As noted in Muscio and Pozzali (2012), a detailed analysis of the process of university-industry collaboration must take into consideration the complex interplay among the variables driving knowledge transfer at different levels: the system level, described in the systems of innovation literature (Edquist, 2005); the institutional level, which explains the differences among universities operating within the same system (Di Gregorio and Shane, 2003); and the individual level (Bercovitz and Feldman, 2008).

Universities have several benefits from engaging in knowledge transfer activities. These benefits are often associated to patenting and licensing activities (Baldini et al., 2007) and include: the increase of financial earnings that can be devoted to research activity (AUTM, 2003; OECD, 2003); the reinforcement of university reputation, which contributes to the recruitment of the smartest students and the brightest faculty (Florida, 1999); the establishment of communication channels with companies that can bring a number of benefits such as the generation of new research ideas and a better understanding of the application of theoretical fundamentals, training for PhDs, internships and jobs for students (Muscio, 2008).

Therefore, universities need to find a way at the institutional level, to regulate and manage a relatively new set of activities. Knowledge transfer activities are not something new to universities, ‘‘somehow’’ discovered in recent years, as argued by scholars in the Triple Helix or Mode Two traditions (Etzkowitz and Leydesdorff, 2000; Gibbons et al. 1994), who propose the idea of a new academic revolution that is characterized by universities becoming involved in knowledge transfer activities (Geuna and Muscio, 2009). However, what is new to academia and to knowledge transfer activities is the institutionalization of university–industry linkages through the direct involvement of the university. In other words, the increased scale and complexity of universities' knowledge transfer activities have brought the need for an improved governance system that can cope with both the university's increased size and complexity and its highly specific and diversified group based production (Geuna and Muscio, 2009).

(2) University policy for knowledge transfer

Few studies have underlined the importance of universities' regulation and the adoption of an institutional strategic approach towards the valorization of their research in fostering knowledge transfer (Siegel et al., 2007). According to Debackere and Veugelers (2005) in order to facilitate knowledge transfer, universities need to set up a clear strategy, establishing a set of guidelines to manage the transfer process, without hampering teaching and research activities.

The definition of an institutional strategy may increase the commitment of faculty members on the third mission, increasing the pace of technology transfer activity. Caldera and Debande (2010) provide evidence of the potential effects of university regulation on both frequency and financial amount of R&D contracts. They find that the university rules on conflicts of interest have a positive effect on the amount and volume of R&D contracts. This indicates that a regulation clarifying potential conflicts of interest between researchers teaching and external activities can improve performance by reducing moral hazard problems and uncertainty in the appropriation of revenues from external research activities. Secondly, the authors find that university regulation of the participation of researchers in R&D contracts as well as rules on copyrights from inventions both have a negative effect on the number of R&D contracts, but no effect on income. These rules give the university the right to share with the researcher the benefits from the commercialization of the IPR generated by an external research activity. This result therefore suggests that such rules hurt university commercialization activity by decreasing researchers' incentives to engage in external activities.

(3) Incentives

The personal involvement of faculty is considered critical for the process of transferring technology from universities to firms, especially because most university technologies are embryonic and need further development in order to become a real commercial asset (Thursby and Thursby 2003, 2004). Etzkowitz (1998, 830) describes how different degrees of involvement with private firms arise, from 'hands-off' scientists who leave all such arrangements to the university technology transfer office (TTO), to those preferring a ‘seamless web’ who actively seek to integrate their research with the research programmes of their collaboration partners.

The effects of applied activity on academic research are still debated (Musco et al., 2013). In principle, as suggested in Baldini et al. (2007), one problem associated with universities’ interaction with firms is the possibility of having delays in publications (Rahm, 1994; Blumenthal et al., 1997; Cohen et al., 2002), which could slow down career advancements of faculty members. The negative effects of patenting activity on career advancements are highlighted also in Siegel et al. (2003). Moreover, Jensen and Thursby (2002) point to the risk that, especially in Europe, researchers will reduce time devoted to research in order to deal with the legal and bureaucratic issues. However, Muscio and Pozzali (2012) find no evidence of any negative effect of interactions with industry on academics’ perception of the factors hampering technology transfer. Supporting this, OECD (2003) stress the positive influence of patenting on researchers’ careers and earnings (OECD, 2003).

The empirical literature is largely focused on the role of governance in providing the right incentives to academics to disclose their inventions to business or to university intermediaries such as TTOs. Recent evidence suggests that adequate university policies may encourage academics to disclose their inventions, fostering commercialization. Jensen and Thursby (2001) and Macho-Stadler et al. (1996) show that well-defined licensing contracts can address, at least in part, the problems highlighted in Siegel et al. (2007) concerning inventions’ disclosure to TTOs. In fact, according to Lach and Schankerman (2008) universities giving a higher share of royalties to the inventor generate more inventions and higher licensing income.

Indeed, a key issue in stimulating knowledge transfer is the rewards faculty members receive for their participation in these activities. As pointed out in Geuna and Muscio (2009) There are a variety of mechanisms used to reward faculty for knowledge transfer activities, such as the inclusion of patents and licenses among the criteria for promotions and tenure negotiations, or the attribution of a larger share (relative to that retained by the department/university) of licensing or equity revenues to faculty members.

Moreover, adverse selection issues play a key role in determining the right incentives: according to Siegel et al. (2007b), university and TTOs’ strategy are likely to be determined by the university’s perception of the expected financial returns from invention disclosure and their desire (or commitment) to generating economic/knowledge spillovers to the community.

(4) Technology transfer intermediaries

The technology transfer literature focuses on whether intermediation between businesses and academics helps to reduce the ‘cognitive distance’ between them, and stimulates knowledge transfer (Muscio and Nardone, 2012). Festel (2012) highlights that in order to facilitate technology transfer from academic research to industrial applications many universities have implemented technology transfer offices (TTOs), entrepreneurship centres and incubators (Goldfarb and Henrekson 2003; Bercovitz and Feldmann 2006; Rasmussen et al. 2006). In recent years, there has been a substantial increase in public and private investment in TTOs (Link and Scott 2007; O'Gorman et al., 2008). As evidenced in the AURIL and Proton surveys for Europe, and the AUTM surveys for the US, the number of TTOs in both Europe and the US has increased dramatically since the late 1990s (Muscio, 2010). Despite, divergences of opinion about what constitutes a viable indicator of TTO performance (Rothaermel et al., 2007), many countries have conducted assessments of TTOs' efficiency and there is no conclusive evidence on their contribution to knowledge transfer. Coupé (2003) finds evidence that those US universities that established a TTO do seem to have increased their patenting activity more than those that did not. However, Siegel et al. (2007) find evidence that the involvement of TTOs may slow down the commercialization process due to a keenness to safeguard researchers' interests and maximize university returns. In the case of the UK Chapple et al. (2005) find relative inefficiency among older TTOs and those located in large academic institutions. In the case of Italy, Muscio (2010) finds that the establishment of a TTO does not drive the frequency of university-industry interaction. However, the author also finds out that business-oriented management of TTOs and greater receptiveness of university departments to TTO services, positively affect the probability of the TTO being involved in university–industry collaboration.

The perverse effects of the policies adopted by university managers of US TTOs are highlighted in Litan et al. (2007), who find that in too many cases, TTOs become bottlenecks rather than facilitators of innovation dissemination. The authors stress that the implementation of what they define as the ''revenue maximization model of technology transfer'', inhibits innovation dissemination, rewarding university TTOs on the basis of the revenues they generate rather than the volume of inventions that universities transfer to industry.

Finally, to make things even more complicated, as noted by Siegel and Phan (2005), university TTOs are increasingly encountering a key strategic choice in commercializing IP via the promotion of licensing or spin-offs. This complicates even further the impact of strategic choices regarding royalty regimes that academic institutions take in the attempt to maximize (or not) income distribution and frequency of university–industry interactions.

3 Empirical analysis

3.1 Data and research methodology

The empirical analysis is based on three main sources of data. The first source is based on MIUR data on volume and sources of academic department funding and research staff composition for the years 2005-2011. The database includes 1,170 academic departments from 55 public universities (4 of them are polytechnic universities) located in 48 municipalities. We considered in the analysis all departments for which financial data was available for at least three consecutive years over the period 2006-2011. Financial data were matched to an index of research quality constructed using the evaluation of research output carried out over the period 2001-03. This composite indicator takes into account peer review evaluations of research activity carried out at academic institutions (patents, impact factor of journal articles, etc.).

The second data source is based on a questionnaire survey, carried out in 2013, addressed to university central administration offices. Respondents completed a short questionnaire requesting information on universities' technology transfer policies as expressed in the so-called "regolamento conto-terzi". The survey investigated about university internal rules regulating the following aspects: (i) presence of rules regulating private contracts, intellectual property rights and the creation of spin-off; (ii) academic scientist conflict of interests between teaching and other external activities; (iii) the amount of resources withhold in order to cover internal costs; (iv) the presence of a limit (ceiling) for extra remuneration of researchers and administrative involved in external consulting activity; (v) presence of charges for patents transfer; (vi) withholdings on royalties from the sale of IP and (vii) the inventor royalty share. We collected information on the governance of 61 universities (out of 73) in Italy.

The third main data source is based on a web survey carried out in 2007 on university technology transfer activities. From the results of the interviews to 197 academic departments in Italy we obtained data on the characteristics of university TTOs such as the year of creation of the TTO, and TTO management background (see Muscio, 2010).

3.2 Econometric specification

Table 1 presents information on the variables used in the analysis. The dependent variable is the amount of funding raised by university departments as a result of research to order (contracts and consultancies) commissioned by public and private organisations and subject to university regulations (F_PRIVATE). Following Perkmann and Walsh (2008), research can be distinguished in: research-driven consulting (contract research commissioned by firms); opportunity-driven and commercialisation-driven consulting (research or advisory services provided by individual academic researchers to industry clients). We use F_PRIVATE as defined above as a proxy for the department performance in being engaged in university–industry collaborations.

Among the explanatory variables we include controls for university technology transfer policies and the characteristics of technology intermediaries (age, management, etc.) in order to estimate the effect of university policies on departments technology transfer performance.

Variable	Definition
f_private	Volume of funding from research contracts and consultancies from public and private organisations raised in the last financial year (2006-09)
University technology transfer policies	
reg_pt	Regulation private contracts (yes/no)
Conflict	Rules regulating teaching and research activity (yes/no)
With	Withholding from private orders (yes/no)
amm_withh	Total amount of withholdings (%)
limit_com	Limits on individual compensations (yes/no)
reg_ip	Regulation intellectual property (yes/no)
reg_pat	Regulation patents (yes/no)
charges_pat	Charges for patents transfer costs (yes/no)
withh_roy	Withholdings on royalties from the commercialization of IP (yes/no)
roy_ric	Inventor royalty share (%)
reg_spinoff	Regulation spin-off (yes/no)
University technology transfer intermediaries	
Ilo	Presence of an Industry Liaison Office
epo_mngm	Presence at the university of an office managing European patents. Normally this task is carried out by offices for valorisation of research results or by TTOs. These offices have the mission of supporting research staff in commercialising the results of scientific research establishing collaborations and mediating between agents.
ilo_age	Number of years of TTO activity
ilo_univ	ILO at university level
ilo_iter	ILO at inter-university level
ilo_other	Other types of ILO
ilo_ext	Professional non-academic manager
ilo_prof	University professor manager
ilo_adm	University administrative manager
University characteristics	
Polytech	Location of the department in a polytechnic university (four in Italy)
med_school	Presence of a medical school
d1-d4	Size of the academic institution where the department is located. University size is expressed in terms of number of students: 1 small (<10,000); 2 medium (10,000-15,000); 3 large (15,000-40,000); 4 mega (>40,000)
Indicators of local demand for technology	
geo_s, geo_c, geo_nw geo_ne	Geographical location of the department respectively in Southern, Central, North-East and North-West Italy
Epoprov	Number of European patents granted to industrial researchers resident in the administrative province where the department is located during the period 2000-06
Firmsize	Average size of manufacturing companies in the administrative province where the department is located

Departments' source of revenue	
f_ec	Research funding from the EC
f_miur	Research funding from MIUR
f_pbadmit	Research funding from other national and regional governmental bodies
f_uni	Research funding from own university
Departments' characteristics	
p_research	Number of research staff (full professors, associate professors, assistant professors, research officers) and PhD students (2005-09) (2005-09)
sh_s	Share of senior research staff
sh_phd	Share of PhD students
Rating	Research rating published by MIUR in 2007, based on the evaluation of research output carried out over the period 2001-03. This composite indicator takes into account peer review evaluations of research activity carried out at academic institutions (patents, impact factor of journal articles, etc.)
Scientific areas	Predominant departmental scientific research area
a1	SA Mathematics & Computer Science
a2	SA Physics
a3	SA Chemistry
a4	SA Geology
a5	SA Biology
a6	SA Medicine
a7	SA Agriculture & Veterinary
a8	SA Civil Engineering & Architecture
a9	SA Industrial Engineering
a10	SA Humanities
a11	SA Sociology, philosophy and psychology
a12	SA Law
a13	SA Economics and Statistics
a14	SA Political sciences

Table 1 - Variable definitions

Table 2 reports some descriptive statistics for the variables included in the regressions.

As a large fraction the departments have no private funding in the period considered, our dependent variable is partly continuous with a positive and large probability mass at zero. Hence, we model such a response variable in order to account for the presence of a corner solution outcome. We also allow for persistence in the process of collecting private finance by introducing a 1-year lag of the dependent variable, in order to investigate whether an evidence of an accumulation advantage emerges along the lines of the Matthew effect argument (Merton, 1968).

Denote by y_{it} department *i*'s private funding collected at time t, the dynamic panel Tobit model with department unobserved effects is:

$$
\begin{aligned}
&y_{it}^{*} = x_{it}'\beta + c_i + c_t + u_{it}, \quad i = \mathbf{1}, \dots, N, \; t = \mathbf{1}, .., T \\
&y_{it} = \max\left(\mathbf{0}, y_{it}^{*}\right)
\end{aligned}
$$

Where x_{it} is a set of department specific characteristics including controls for university technology transfer policies, c_i are the (random) department-specific effects, ct are the year effects, uit is the error term. The year effects are included to account for cyclical variation in private funding. In order to handle the initial condition problem in dynamic, non-linear unobserved effects model, we follow the methodology suggested by Wooldridge (2005).

The vector x_{it} contains also a set of covariates that might be correlated to the department capability to be engaged in technological transfer activity, such as public funding from MIUR and European Commission, department size (both in term of administrative and research staff), quality/reputation, management, location, research areas and university structural characteristics and external spillovers.

Variable name	Obs.	Mean	S.d.	Min	Max
University technology transfer policies					
reg_pt	61	0.95	0.22	0	1
conflict	61	0.44	0.5	0	1
withh	61	0.93	0.25	0	1
amm_withh	61	0.18	0.17	0	0.86
limit_com	61	0.61	0.49	0	1
reg_ip	61	0.36	0.48	0	1
reg_pat	61	0.75	0.43	0	1
charges_pat	61	0.59	0.5	0	1
withh_roy	61	0.57	0.5	0	1
roy_ric	55	0.49	0.37	0	1
reg_spinoff	61	0.9	0.3	0	1
University technology transfer intermediaries					
ilo	61	0.77	0.43	0	1
epo_mngm	61	0.72	0.45	0	1
ilo_age	47	1.08	2.03	0	8
ilo_univ	47	0.82	0.39	0	1
ilo_iter	47	0.14	0.35	0	1
ilo_other	47	0.04	0.2	0	1
ilo_ext	45	0.16	0.37	0	1
ilo_prof	45	0.52	0.51	0	1
ilo_adm	45	0.32	0.47	0	1
Other University characteristics					
med_school	64	0.56	0.5	0	1
polytech	64	0.06	0.24	0	1
d1	60	0.2	0.4	0	1
d2	60	0.17	0.38	0	1
d3	60	0.47	0.5	0	1
d4	60	0.17	0.38	0	1
geo_c	64	0.23	0.43	0	1
geo_s	64	0.34	0.48	0	1
geo_ne	64	0.2	0.41	0	1
geo_nw	64	0.22	0.42	0	1
epoprov	64	9.93	17.13	0	58.7
firmsize	64	7.72	2.36	3.11	11.78
Department characteristics					
f_ec	5636	2.5	10.65	0	426.5
f_miur	5636	2.22	5.12	0	152.4
f_pbadmit	5636	3.43	9.79	0	243.42

f_private	5636	5.82	11.53	0	162.29
f_uni	5636	3.35	3.75	0	47.4
p_research	5636	32.32	19.95	2	201
sh_s	5636	0.3	0.1	0	0.93
sh_phd	5636	0.26	0.17	0	1.15
rating	5636	0.78	0.1	0.37	1
SA	-	-	-	-	-

Table 2 – Descriptive statistics

3.3 Results

Table 3 reports the estimation results for the tobit model. Column (1) refers to a linear model that ignores the presence of a corner solution. Column (2) reports the result for the pooled tobit model that ignores for the presence of unobserved random effects, while column (3) and (4) focuses on the unobserved effects dynamic tobit model which is our preferred specification.

Dependent variable: f_private	*OLS*	*Pooled tobit*	*Unobserved effect tobit*	
	(1)	(2)	(3)	(5)
University technology transfer policies				
reg_pt	1.312	2.432	3.103	2.687
	(0.627)**	(0.829)***	(1.059)***	(1.481)*
conflict	-0.164	-0.691	-0.670	-0.104
	(0.253)	(0.329)**	(0.420)	(0.615)
amm_withh	0.036	0.718	0.764	0.642
	(0.318)	(0.410)*	(0.524)	(0.644)
limit_com	0.040	-0.979	-0.972	-1.499
	(0.332)	(0.434)**	(0.549)*	(0.852)*
reg_ip (y/n)	0.483	-0.729	-0.861	-0.859
	(0.421)	(0.553)	(0.704)	(0.937)
reg_pat	1.601	0.361	1.071	0.722
	(0.648)**	(0.849)	(1.089)	(1.398)
charges_pat	-0.802	-2.387	-3.427	-3.310
	(0.602)	(0.798)***	(1.023)***	(1.327)**
withh_roy	-0.469	0.971	0.775	1.316
	(0.415)	(0.540)*	(0.692)	(1.003)
roy_ric	-0.331	1.155	1.056	1.657
	(0.417)	(0.546)**	(0.648)*	(0.946)*
reg_spinoff	-0.001	-2.622	-2.744	-1.866
	(0.840)	(1.433)*	(1.441)*	(1.479)
Technology transfer intermediaries				
ilo	0.523	0.871	1.148	0.246
	(0.416)	(0.551)	(0.685)*	(1.987)
epo_mngmt	-0.373	-0.521	-0.755	0.394
	(0.398)	(0.517)	(0.653)	(1.005)
ilo_age				0.106
				(0.141)
ilo_univ				0.303
				(1.547)
ilo_prof				0.141
				(1.172)
ilo_adm				-0.489
				(1.154)
University characteristics				
med_school	-0.767	-2.493	-2.844	-3.462
	(0.344)**	(0.454)***	(0.577)***	(0.661)***
polytech	1.227	1.638	1.633	0.367

	(0.729)*	(0.926)*	(0.981)*	(1.295)
d2	-0.850	-2.828	-3.038	-1.396
	(0.575)	(0.758)***	(0.964)***	(1.169)
d3	0.434	0.845	0.991	1.571
	(0.499)	(0.645)	(0.819)	(0.994)
d4	0.273	2.228	2.582	3.134
	(0.617)	(0.793)***	(1.011)**	(1.220)**
Other financial revenues (departments)				
f_private(-1)	0.699	0.724	0.613	0.652
	(0.009)***	(0.011)***	(0.019)***	(0.024)***
f_miur(-2)	0.062	0.081	0.093	0.090
	(0.016)***	(0.019)***	(0.020)***	(0.021)***
f_ec(-2)	0.023	0.025	0.026	0.026
	(0.012)*	(0.014)*	(0.015)*	(0.015)*
f_uni(-2)	-0.021	-0.028	-0.019	-0.053
	(0.028)	(0.035)	(0.037)	(0.038)
f_pbadmit(-2)	-0.019	-0.002	-0.004	-0.005
	(0.011)*	(0.013)	(0.014)	(0.015)
Other department characteristics				
a2	-0.046	-0.216	-0.221	-0.336
	(0.667)	(0.845)	(1.097)	(1.051)
a3	0.687	2.254	2.504	2.490
	(0.611)	(0.758)***	(0.987)**	(0.949)***
a4	1.785	3.775	4.311	4.135
	(0.763)**	(0.937)***	(1.224)***	(1.173)***
a5	0.419	1.323	1.762	1.704
	(0.563)	(0.709)*	(0.917)*	(0.886)*
a6	1.426	2.527	2.790	2.832
	(0.487)***	(0.614)***	(0.796)***	(0.772)***
a7	1.397	3.320	3.753	3.856
	(0.605)**	(0.757)***	(0.980)***	(0.976)***
a8	2.755	4.421	5.300	5.306
	(0.560)***	(0.698)***	(0.906)***	(0.896)***
a9	4.642	6.066	7.608	7.244
	(0.545)***	(0.677)***	(0.899)***	(0.907)***
a10	-0.730	-5.510	-6.172	-6.004
	(0.526)	(0.717)***	(0.915)***	(0.891)***
a11	-0.468	-2.371	-2.813	-2.653
	(0.551)	(0.721)***	(0.925)***	(0.903)***
a12	-0.364	-3.524	-4.144	-3.832

	(0.564)	(0.759)***	(0.971)***	(0.956)***
a13	0.277	0.533	0.241	0.478
	(0.585)	(0.747)	(0.965)	(0.949)
a14	-0.264	-0.104	-0.455	-0.176
	(0.684)	(0.870)	(1.122)	(1.094)
rating	1.159	3.637	3.236	5.431
	(1.437)	(1.888)*	(2.406)	(2.459)**
p_research	-0.005	0.015	0.013	0.014
	(0.005)	(0.006)**	(0.008)*	(0.008)*
sh_s	0.470	0.471	0.740	0.491
	(1.005)	(1.314)	(1.599)	(1.577)
sh_phd	-0.287	-0.141	-0.147	-0.140
	(0.586)	(0.768)	(0.889)	(0.891)
Geographical characteristics				
geo_s	-0.678	-3.825	-4.496	-2.634
	(0.741)	(0.967)***	(1.231)***	(1.324)**
geo_c	-0.612	-2.435	-2.997	-2.150
	(0.637)	(0.813)***	(1.045)***	(1.130)*
geo_ne	-0.628	-1.753	-2.100	-2.223
	(0.490)	(0.616)***	(0.795)***	(1.167)*
epoprov	0.016	-0.043	-0.047	-0.049
	(0.018)	(0.023)*	(0.030)	(0.035)
firmsize	0.090	0.107	0.097	0.424
	(0.083)	(0.107)	(0.136)	(0.172)**
Constant	-2.607	-2.905	-2.456	-8.816
	(2.321)	(3.031)	(3.860)	(3.722)**
Year dummies	yes	yes	yes	yes
Observations	5636	5636	5636	5636
Number of n	-	-	1170	1170

Table 3 - Panel data tobit regressions

Regarding the effect of university technology transfer policies on department external research activity, first the presence of formal rules at University level regulating external research activity has a positive effect on the average amount of private funding received by researchers. This result indicates that a regulation establishing a set of guidelines to manage the transfer process, the role of researchers and institutions has a positive impact on the capability of departments to be engaged in university–industry collaborations. Second, the presence of a limit on the possibility for the researcher to get an economic benefit from her external research activity has a negative impact on the department capability to be engaged in industry collaborations. The same disincentive effect is obtained for the presence of withholdings for covering the costs related to patent transfer. Finally, we find evidence that royalty sharing arrangements are key determinants of performance. The estimated coefficient of the inventor royalty share is positive and significant. The second set of determinants are technology transfer intermediaries. We include dummy for the presence of an Industry Liaison Office (ILO) and/or an office managing European patents (EPO_mngmt). Moreover we control for the characteristics of ILO, such as the age, type and management. The presence of ILO appears to have a positive effect on department external activity (column 3), though such an effect disappears once we control for ILO characteristics (column 4). All the other characteristics do not impact significantly on department eternal research activity. Regarding the remaining variables that control for differences in university and department characteristics reported in Table 4, we find that the presence of a medical school has a negative effect on department funding from external research activity. This is mainly explained by the fact that when medical schools are present they are handled as autonomous cost centres, which means that research contracts and consulting activities are typically managed without involving departments. On the other hand the dummy for polytechnic universities has a positive effect on consulting contract income, thought the effect is only marginally significant. Departments in large sized universities are more likely to be engaged in university–industry collaborations. There are positive effects of critical mass in large academic institutions on business funding expressed in terms of university reputation, visibility and size of research teams. Looking at department characteristics, our regressions show that structural characteristics have an impact on business funding to departments. Departments' capacity of rising resources from private sources largely depends on the type of research carried out inside the departments. Departments assigned to research areas a9 (Industrial Engineering) and a8 (Civil Engineering and Architecture) and to a less extent a7 (Agriculture and Veterinary) are more involved in external research activity. Moreover, we find that research performance (RATING) has a large and significant impact on business funding to universities, which means that high quality research generates valuable intellectual property that can be passed to industry and, secondly, that research performance provides a signal to industry of the best university departments. Finally, the results confirms the public funding (both from national sources and European Commission) play an important role in stimulating university-industry interactions.

4 Conclusions and recommendations

This paper contributes to the understanding of the role of university policies and governance systems on the departments' capability of attracting private funding through consulting and research to order activities. As highlighted, these informal channels of collaborations between university and industry are very relevant in terms of knowledge transfer since they are highly relational and activate important learning by interacting effects (Perkmann and Walsh, 2008). We provide empirical evidence that the presence of a research contracts and consultancies regulation is beneficial to departments and that monetary and income incentives to researchers are crucial in explaining the different performance departments have in terms of collection of private funding from consultancies. In fact, both the limitations to the amount of money that researchers can earn from the participation to consulting and research to order activities and the automatic withholdings that the university at different levels triggers on the total amount of the funding have negative effects on the collection of external funding.

Quite interesting is also the fact that business funding to departments seems to be positively affected by the performance of the academic research, which evidently provides a quality signal to industry, rather than by the presence of Industrial Liaison Offices or European Patents Offices. This suggests that university policies should be more focused on increasing the quality of their research rather than by building up facilities aimed at easing the knowledge transfer process to industry.

Furthermore, the paper confirms the existence of complementarities between public research funding (in its several forms) and funding from consulting and research contracts activities, in line with other recent scientific contributions.

To conclude, it is a well known fact that Italian universities are facing a decline in the public funding received and it is reasonable that, in case of consulting and research to order activities which rely on the use of university facilities (i.e. laboratories, technical and administrative personnel), the university trigger a withholding on the related earnings (at least to cover the costs beared). But it often happens that the withholding percentage is independent from the scientific area and from the actual necessity of accessing to university facilities, as well as that the percentage be determined arbitrarily and without any cost orientation. Furthermore, the resources collected by university through the withholding are often destined to monetary incentive programs for administrative personnel which nothing have to do with the research that generats the revenue. Such settings can be very detrimental in terms of reduced incentives for researchers to carry out consultancies or, in the best cases, can induce researchers to supply research activities to industry without a direct involvement of the department which they belong to (especially when no university technical facility is needed, e.g. for humanities).

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The Knowledge-Based Economy As A Key Legitimating Concept Of The Neo-Liberal University In The EU

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Abstract

In the last decade the European Union (EU) has positioned higher education as a basis for achieving the goals of increased economic development and prosperity. A key idea behind this was that a strong emphasis on higher education would potentially lead to a knowledge-based economy. The pre- existing approach that emphasised the intrinsic value of knowledge was altered to focus more on future employability and competency as instrumental outcomes of higher education.

In this paper I critically assess the course of recent EU higher education policies starting from the turn of the new millennium, by exploring accounts concerning the emerging relationship between the knowledge-based economy and higher education. I discuss these reorientations of policy in relation to a deeper and more insidious project of neo-liberal reconstruction, which has led to various controversies and tensions regarding the function of the university in the 'new knowledge era'. I examine the use of the 1960s Human Capital Theory (Becker, 1964; Drucker, 1969), which has served as a key justification for the later all-embracing but in fact partially applicable concept of knowledge economy, underpinning much of EU higher education policies at present. I discuss this criticism of the cloudy idea of the knowledge-based economy referring particularly to the recent work of Michael Young (2008; 2010) and also to Michael Gibbons (1994) as one of the early and most influential works that put forward an analysis of the knowledge economy and its impact on universities.

I conclude by suggesting that the EU has opportunistically over-emphasised and over-extended the assumptions about the knowledge-based economy and its holistic outreach, so to legitimise policies framed within a wider neo-liberal ethos, which is not intrinsically part of the knowledge-based economy as such. Although the concept of the knowledge-based economy and the neo-liberal idea are chronologically sequential they - in my judgment - do not rationally supersede each other.

Keywords

Knowledge-Based Economy; Human Capital; University; European Union.

1 Introduction

In the last two decades the European Union (EU) has positioned higher education as a basis for achieving the goals of increased economic development and prosperity. A key idea behind this initiative was that a strong emphasis on higher education would potentially lead to a knowledge-based economy. The relevant terminology used in the education sector has changed considerably during this period. The pre-existing approach that emphasised the intrinsic value of knowledge was altered to focus more on future employability, economic growth and competency as outcomes of higher education.

In year 2000, the EU adopted a wider development strategy called the Lisbon Agreement. The Strategy was set to address the challenges of the globalising world and to contribute towards the positioning of the EU as the most competitive and dynamic knowledge-based economy in the world (European Council, 2000); whilst European education would become a “world reference” (European Council, 2002: 19) standard by 2010.

More than a decade after that being stated, the European Commission has concluded that across the EU member states, four out of the five education targets set in the Education and Training 2010 have not been achieved, except for the benchmark on increasing the number of MST graduates (European Commission, 2011a). In terms of higher education, it admits that with attainment levels of just over 30% from the relevant age group (25-34 year-olds), the EU remains “far behind the performance of both the US and Japan (European Commission, 2009: 11), which are currently above 40%. Moreover, investment in higher education has been noted as too low (European Commission, 2011b) and it is emphasised that “the EU member states would need to invest on average 10.000 Euros more per student per year in higher education to reach the levels of the US” (European Commission, 2009:11).

Under these circumstances, the Union in 2010 agreed upon a new EU 2020 Strategy that would potentially address the problems of the previous Strategy in place and put Europe back on track towards sustainable economic recovery (European Commission, 2010b). The declared objective of the new Strategy was to “deliver smart, sustainable and inclusive growth” (European Commission, 2010a: 3) that will create new jobs and push forward the economic revival of the Union. Specifically, in terms of higher education the general charting of a course towards the goal of achieving a knowledge-based economy remained, with the higher education attainment target now been given a higher level of importance as a headline target.

The wider economic realities in the EU that are shown to be highly uncertain and fragile especially but not only since the economic downturn in 2008 added increasing legitimacy to those knowledge concepts that view higher education as a form of productive capital. The growing exposure of education to market forces and especially market ‘realities’, as part of a wider extension of market logic across public institutions, has now repositioned universities as institutions increasingly concerned with extrinsic outcomes; where the pursuit of knowledge itself becomes less of priority to objectives such as wealth creation (Stehr, 1994).

As I will argue bellow, the European Union central bodies have, since the turn of the new millennium, promoted a discourse derived from the 1960s Human Capital Theory (HCT) and elaborated in terms of the knowledge-based economy to priorities an increasingly instrumental view of higher education which primarily serves an economic centered aim. I further argue that from 2000 onwards the knowledge-based economy becomes opportunistically over-extended to legitimise a neo-liberal agenda that is not intrinsically part of the knowledge-based economy as such. In this sense I critically discuss these reorientations of policy in relation to a deeper and in many instances concealed or omitted project of neo-liberal reconstruction. I also discuss the cloudy idea of the knowledge-based economy referring particularly to the recent work of Michael Young and also to Michael Gibbons as one of the early and most influential works in the field that put forward an analysis on the knowledge-based economy and its impact on universities.

2 The emergence of new modalities of governing times of economic crises

Before proceeding to the key issues of this text related to the ambition and appropriateness of the knowledge-based economy, it seems prudent to begin by highlighting briefly certain major uncertainties surrounding the whole of the EU, in a wider sense than the narrower issue of education policy. This broader understanding of the current situation within the Union may also opens a fruitful debate in the education sector in terms of identifying and assessing current policy undertakings, as well as forecasting future outcomes and achievements.

Due to the global impact of the financial crises since 2008, the EU has recently faced numerous economic challenges. The "GDP [of the Union] fell by 4% in 2009, the industrial production dropped back to the levels of the 1990s and 23 million people – or 10% of the active population – are now unemployed […] and it has exposed some fundamental weaknesses of the economy" (European Commission, 2010b: 9). Levels of youth unemployment are even higher – rising to around 50% in Spain and as high as 60% in Greece currently (Eurostat, 2011; 2013).

In such circumstances, when the capacity both of national governments and the EU to directly control and shape economic development has been severely undermined – most basically by neo-liberal globalisation - EU politicians appear to have become more committed to trying to use education as an alternative means to try to solve societal problems and improve economic performance. Education policies have arguably become a surrogate for direct economic influence as nation states increasingly lose effective controls over national economies.

In times of a recession the focus has been shifted to the role of the residual factors that are believed to contribute to economic growth. In their research on the determinants of economic growth, Petrakos et al., conclude that "a large number of studies have found evidence suggesting that 'the educated population' is key non-economical determinant of economic growth" (2007: 7). This interpretation that focusing on educational reform can significantly influence the economy seems to have been remarkably durable and appealing to - as well as applicable by - politicians of both the centre-right and centre-left across Europe.

The challenge ahead of the EU mainly driven by its economic uncertainties may be understood by invoking the concept of ‘governmentality’ – a term developed by Foucault (1979) and further elaborated by Rose (1999) in order to conceptualise the problem that exists for any of those who govern or aspire to govern (whoever they may be), which highlights the point that governing must always have reference and application to potentially problematic and sensitive areas (e.g health, education). The ‘targets’ of governmental strategies are often institutional populations within specific institutions – especially but not exclusively ones that are run and funded by state agencies. This raises a general question; how they should be governed or instrumentalised – through what discourses and ‘technologies’ (not in a narrow sense, but in a broader Foucaultian intellectual tradition conceived of as institutional calculation mechanism) of power-knowledge (Rose, 1999).

In this sense, those who govern are not a neutral spectator of the transforming landscape of higher education, but rather the most influential driving force behind the process. The danger is that the ideologically driven and politically led ambition to restructure higher education in compliance with governmental rationales and imperatives as the knowledge-based economy may result in the obsession to repeatedly make changes to higher education policy, rationalised by arguments about wider social and economic challenges that remain to be addressed. This inadequate understanding and use of higher education to fix social ills could entail, Collini suggests, further “damage to the very things they [politicians] claim to be supporting” (2012: 38) (my italics). In this respect, like many other conservative writers on education, he argues that it is preposterous to believe that higher education, on its own, can resolve all or most economic and social problems or shortcomings.

3 The rise of human capital theory in Europe

The understanding that there is a strong and empirically verified positive relationship between income, level of education and economic growth, both for individuals and nations can be traced back to the 1960s and what is called the Human Capital Theory (HCT). This relationship, as cited by many (Shultz, 1961; Becker, 1964; Bell, 1973; Mincer, 1974), holds, it is claimed, across different societies as a universal phenomenon, where human capital is seen as comparable to more tangible means of production.

The earliest stage of debates surrounding the relationship between ‘the new economy’ and knowledge were focused primarily on economic priorities - and not so much on the content of education. In fact, the origins of this kind of thinking can be traced back to the late 1960s and the work of the management writer Drucker (1969; see also 1981; 1999) who first coined the term ‘knowledge economy’ - which later on becomes the catch phrase of many - to suggest that the economy of the future will heavily rely on the application of knowledge. In addition, the HCT became a general point of reference for later theories that placed knowledge at the centre of the wealth creation process.

A decade after the emergence of HCT across Europe and especially Western Europe, there has been, as poststructuralist theorist of governmentality see it, a drastic shift towards a neo-liberal mode of governing, most significantly within public sector or public funded institutions (Rose, 1999; Ball, 2007). The shift towards – in the words of Rose – governing in an advanced liberal way, became increasingly influential and pervasive following the crises of social democracy of the mid-1970s. The constellation of events at that time – e.g the oil price shock and the end of the long boom of full employment in Western Europe – created space for the 'New Right' to come into existence and display an increasingly effective critique of the alleged failures of social democracy; and what was considered to be its non-accountable, bureaucratic, unresponsive and highly centralised public service and welfare sector. The critique was initially most dominant in all the 'Anglo-Saxon' economies – US, UK (and Canada, Australia and New Zealand to some extent) – which increasingly embraced neo-liberal modes of governing.

During the 1980s the influence of neo-liberal ideas and reforms become rapidly popular even within the more strongly social democratic countries of Western Europe – Germany, France, even Scandinavia being penetrated by this agenda. Although some of these countries have preserved a significant element of social democracy, there has been significantly more effective legislation in favour of opening up nation to a global open market, which has contributed to a major erosion of public funding and, to a varying degree, the decline of the social idea of citizenship. Notions of entitlement to welfare and publicly supported education were increasingly undermined and deeply affected by what can broadly be called the neo-liberal restructuring across all of these countries, particularly in the public sector. That this is in part a new modality of governing and not simply the rise of a 'New Right' ideology is indicated by the vigour with which ostensibly 'socialist' parties such as for example 'New Labour' in the UK promoted gradual erosion of welfare entitlement and intensified managerialisation across the public sector.

An emerging ground of skepticism in respect to the HCT – most notably after the crises in 2008 – is that it is virtually impossible to precisely foresee the future demands for 'graduate level' employees regardless of the discipline. In this direction, Wolf (2002) argues that the links between economic growth and higher education are considerably less clear than what is suggested or perhaps desired by policy makers, human capital theorist or knowledge-based economy supporters; since a number of supplementary criteria (e.g social background and mobility, ethnicity, race, even sheer luck) shape economic potential and influence occupational possibilities. In this sense, current market conditions have been poorly assessed by human capital theorists and as such, the notion of supposedly persistent and automatic contribution of any higher education discipline concerning economic efficiency illustrate significant limitations.

We need to look at two possible factors that shape this situation, which is, partly due to problems specific to the EU; extremely acute. One is the long-term phenomenon of credential inflation along with the record high unemployment rate (around 10% across the whole EU) and youth unemployment reaching 22% in 2011 (Eurostat, 2011). A large number of employers confronted with the economic downturn are not able to deliver jobs and wages expected to be associated with different levels of education. In fact, the Union is in a situation whereby often people with a higher education degree are forced to move down the occupational pyramid and take positions that are not necessarily relevant to their educational qualifications. A recent European Commission document reveals that "20% or more of young workers with tertiary education are employed beyond their theoretical skill level" (European Commission, 2011a: 79). Figures reach as high as 30% in Spain and Greece. Thus, the claimed higher earning potential as suggested in salary tables demonstrates considerable limitations, and this can apply even in relation to exceptional science students, who are often in a weak position to compete with the relatively cheap but in most cases equally qualified labour force - especially those in the Far East.

In the mean time the EU has failed to adequately and jointly address the problems associated with wage and social dumping. Very little has been done to tackle this international challenge –a failure which has become more politically problematic very recently when there are signs of growing populist support for various forms of economic protectionism in several EU nations – which make much of the claim that the "EU jobs for EU workers" are in fact becoming jobs available far from home, resulting in descending income levels across European nations.

Another related problem is that in a world where a high proportion of investment is controlled by trans-national or global corporations intent on profit maximisation, some of it relatively short-term, national and trans-national governments like those in Europe are often in a weak position to influence such investment decisions. Therefore, it is by no means obvious that investing into higher education will automatically help the recovery of the EU economy as a whole, still less some of its weaker member nations, to grow more effectively.

Simon as early as 1985, for instance, warned that education has been often misdirected from its potential to produce social change in the direction of greater social justice. All this, he writes, has been overthrown by the statistical obsession of policy makers to demonstrate relationship between the level of education and distribution of income (Simon, 1985).

Michael Young (2008; 2010) develops a political and philosophical critique from this standpoint, emphasising that one central problem of the knowledge economy and all the policies that follow on from it, is that in a sense they have forgotten or overlooked more fundamental questions about what education should be about and what its should be concerned with. He points to the change of universities in the modern era, which have produced an alienation from the idea of the pursuit of knowledge for its own sake towards activities shaped by the pursuit of knowledge in the service of an external interest – especially commercial and vocational interest and perceived pay-offs.

Young's work can be located epistemologically within what is called social realism (itself underpinned by critical realist philosophy), as a theory of what is important to know (Maton & Moore, 2010). They (social realists) emphasise that education should first and foremost though, not neceserally exclusively, in favour of the transmission of knowledge grounded in intellectual disciplines, and such knowledge should be the basis of helping young people to understand their lives, their surroundings and the society they live in. In this respect, they can be located in the many strands of those who support 'liberal education'.

In contrast, Gibbons et al. (1994) as one of the most influential representatives of the new production of knowledge advocate for a reorientation of the tradition of higher education, suggesting that in an age of uncertainty we should rethink how science, and hence knowledge, is perceived, acquired and made available. They suggest that the traditional definition of knowledge – as self contained activity – should be abandoned and replaced by a more provisional and pragmatic view towards scientific knowledge; as a problem-solving category or what they refer to as "contextualised knowledge" (Gibbons et al., 1994)

4 The knowledge-based economy – A legitimating concept of the neo-liberal university in the EU

Many recent commentators such as Castells (1996), Stiglitz (1999), Jones (1999), Lauder et al. (2012) have critically discussed, the 1960s HCT concept and the knowledge economy and its association with the new liberal ideology, emphasising the penetration of knowledge into the marketplace, and how it fundamentally changes the basis of economic activities. These authors view the knowledge economy concept as one of the most effective and most important legitimising ideas associated with the neo-liberal changes.

In this context, the discussion of the knowledge-based economy is therefore not an entirely new or unique phenomenon. Many economists discussed the concept and its application to higher education, long before it was installed as part of the dominant EU paradigm in 2000 with the launch of the Lisbon Strategy.

However, what are indeed new, in my judgment, are the scope and the extent to which the knowledge-based economy has become recognised and embraced by most EU policy makers, politicians and many university managers, from the beginning of the new millennium, most importantly under the rise and wider influence of neo-liberalism. The two interlinked agendas (the knowledge economy and the neo-liberal reforms), I argue, have both dramatically impacted on reforms of higher education, with the neo-liberal reforms arguably being more important. They have worked together to radically change the character of the universities in a highly instrumental direction.

At the policy level, the origins of this thinking, where knowledge is seen as the main source of economic growth, can be traced back within EU institutions, to the mid 1990s, through a sequence of documents created by international organisations such as the OECD and the World Bank (Peters, 2004). The earliest traces of the term ‘knowledge-based economy’ are commonly found in a key document published by the OECD in 1996 under the title The Knowledge-based Economy, where knowledge is depicted as playing a crucial role as “the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance” (OECD, 1996: 3); an idea that was well established in OECD’s earlier work, but not encapsulated under a single catch phrase (Godin, 2006). Following the same line of argument in the 1998 World Development Report, the World Bank noted that “most technologically advanced economies are truly knowledge based” (World Bank, 1998: 17); a paradigm that became increasingly dominant in the work of the Bank throughout the following decade.

One of the earliest definitions, on a national policy level, drawing attention to the concept of knowledge-based economy is presented by The department of Trade and Industry (DTI) in the UK, as part of the White Paper: Our Competitive Future – Building the Knowledge Driven Economy where the knowledge-based economy is characterised as “one in which the generation and exploitation of knowledge has come to play the predominant part in the creation of wealth” (DTI, 1998).

Despite the unquestionable influence of the OECD, the World Bank, and some national governments, as early promoters of the knowledge-based economy concept, it is the EU that established it as a dominant paradigm on the European horizon. The European Council in year 2000, agreed upon the so called Lisbon Strategy, a primarily economic framework to address the challenges of next decade, where the declared objective was to prepare and position the EU economy as the most competitive and dynamic knowledge-based economy whereby higher education was considered to be the main engine of economic growth and successful transition to a knowledge-based economy. In this context, the specific higher education objectives set, were contextualised as instruments to serve the economic ambitions of the Lisbon Strategy.

An identical, perhaps even intensified, neo-liberal rhetoric towards the knowledge-based economy as a model to follow was embraced specifically after the mid-term review of the Lisbon Strategy in 2005 when the EU concluded that fairly limited progress had been made over the first five years (Kok, 2004); which placed even more pressure on universities to focus on growth creation and employment-related training. For instance, the Commission report on the modernisation agenda for universities - following the re-launch of the Lisbon Agenda in 2005 - highlighted the enormous potential universities as a force of growth, however at the same time it attacked universities as rather closed institutions and alleged they still undervalued "the potential benefits of sharing knowledge with the economy" (European Commission, 2006: 4).

In this regard, there seems to be an increasing tendency to display and ascribe many of the economic shortcomings of EU economies to supposed fundamental weaknesses of higher education institutions. This strategy is close to what Rose (1999) refers to as "governing at a distance". A concept by which governments (in the EU's case the trans-national government) failures of delivery are presented as management failures amongst the management of lower level institutions, in this case universities. Ultimately it is universities that are held to be responsible in case of wider policy underperformance or malfunction, while government officials still claim credit in case of success. The growing realities of increasing unemployment and economic recession due to the global impact of the financial crises that have taken place since 2008, produce more such rhetoric, particularly in those member states which were most severely exposed to their effects.

In such pervasive economic uncertainty, where the economic development of Europe as a whole has been shown to be highly uncertain and, in the context of the gathering Euro crisis, even perilous, with numerous radical, though speculative claims surrounding its future, the EU in 2010 introduced a new 2020 Strategy for smart, sustainable and inclusive growth as its overarching 'exit strategy' from these wider economic crises (European Commission, 2010a). Very similar to the Lisbon Agenda, the new EU 2020 Strategy expressed a re-commitment towards the knowledge-based economy, however this time a new umbrella term 'smart growth' was introduced to legitimise the, now, camouflaged knowledge-based economic concept.

Godin in his analysis of key OECD documents discusses the preoccupation, even obsession of current policy-makers to reduce complex concepts such as the knowledge-based economy into 'buzz' words that "help sell ideas since they are short, simple and easy to remember" (Godin, 2006: 24) (my italics). He further argues, in some ways similar to Rose, that these conceptual frameworks are very fertile, both empirically and theoretically, for the introduction of new discourses or intensification of existing policy trends.

The newly coined concept presented in the EU 2020 Strategy did not go substantially beyond the mere rhetoric of being a progressive neo-liberal economic manifesto. An insignificant fraction of the document corresponds with the opening sentence of the preface that urges that the Strategy must mark a new beginning. Again, the new Strategy gives rise to concerns about the predominant instrumental role accorded to education. The same applies to the other priority areas of the Strategy (e.g. employment, research and development, poverty reduction and environment) where disproportionate emphasis has been given to the social rather than economic outcomes.

For example, the Strategy's headline target for reaching higher education attainment of 40% by year 2020 is almost exclusively contextualised through the narrow prism of the knowledge economy; even in this economically specific context the document is profoundly lacking in substance and evidenced justification. The initial problem is that the higher education target is almost entirely abstracted from any serious examination or discussion of issues like quality and equal access to higher education, while there is strong and arguably narrow overemphasis on immediate economic recovery, most basically to the detriment of long-term educational objectives such as the value of becoming educated as an end in itself.

Instead of being a means to a wider intellectual, cultural and social set of ends, the economy becomes an end in itself. As a result, although one might expect that in a knowledge-based economy, knowledge should be in the centre, paradoxically it is the economy that is being emphasised, whereby knowledge is viewed and treated like any other commodity. In the narrow sense, the insistent refrain is that the university must privilege economic criteria, to justify its worth.

In this sense the partially correct and applicable knowledge economy arguments from the 1960s are used as a very effective legitimating narrative to prioritise and channel a highly instrumental, neo-liberally driven view of universities. Although the concept of the knowledge economy and the neo-liberal idea are chronologically sequential they - in my judgment - do not rationally supersede each other. Thus it is important to separate them out, since in some ways, arguably, the knowledge economy is not a merely legitimating concept.

However, it is not to say that the human capital approach towards the knowledge economy that comes through in the 1960s is not merely a legitimating ideology. Clearly there is an element of correct analysis in those knowledge economy arguments and undeniably, certain major sectors of contemporary economies are indeed, for their competitiveness and innovativeness dependent upon the advance of specially applied scientific and mathematical knowledge, as suggested by the HCT. Thus, the knowledge economy arguments are valid and directly functional for the effectiveness at the cutting edge of certain kinds of research and industries, which are largely knowledge-dependent. Gibbons et al. (1994), for example, rightly suggest that the interface between science subjects and the high technology industrial sectors is blurring, with a significant cross-fertilisation taking place. Yet, it seems that the EU higher education framework overstates the importance and extent of the knowledge economy and its present-day outreach, thus tipping into rhetorical exaggeration.

For example in these so-called economies of Europe, in terms of the pattern of employment across the whole population, a considerably higher proportion of the population is still employed in relatively routine tasks that require very little knowledge and skill. Wolf in her Does Education Matter makes a similar point contemplating that “what the hype about the ‘knowledge economy’ ignores is that unskilled jobs are pretty stable part of the employment scene” (Wolf, 2002: 185). Thus, in a range of ways, it is not entirely a knowledge-based economy or society.

It may be necessary, in this context, to briefly examine key higher education documents before the year 2000 which reveal a further drastic shift in language about the use of knowledge and which has occurred from the Lisbon Strategy onwards. It was only little more than a decade ago when the social dimension of higher education that was most conspicuous in higher education documents on the Europe continent; while emphasis was also placed on the wider importance of knowledge, going beyond the language of the economy and its performance.

For example, the Magna Charta Universitatum (MCU) (1988) signed by 430 university rectors stood for the protection of what were characterised as fundamental university values and rights, wherein the university was acknowledged as a “trustee of the European humanist tradition” with a key goal to celebrate and “attain universal knowledge” (MCU, 1988: 2). The manifesto continued by contending that “the university is an autonomous institution…morally and intellectually independent of all political authority and economic power” (2).

At that time, higher education continued to be seen as a national responsibility; which appeared to safeguard the university from wider political and economic ambitions for some time. For most countries, before the Lisbon agenda, higher education was still a major preserve and responsibility of the nation state, although there was a considerable tendency to establish trans-national statements of competencies on issues related to qualification recognition, compatibility of curriculum and mobility of students and teaching staff. However, in the years after the Lisbon agreement the single economic market and the relatively coherent political framework made it increasingly difficult to isolate an education system just within the nation state; and thus, for nations to resist instrumental priorities attached to the university.

Perhaps, the most explicit example of discursive shift in vision of the universities prime objective is to contrast the text of the Sorbonne Joint Declaration (SJD) (1998), signed by the ministers of four countries, namely UK, Germany, Italy and France, with later documents:

The European process has very recently moved some extremely important steps ahead. Relevant as they are, they should not make one forget that Europe is not only that of the Euro, of the banks and the economy: it must be a Europe of knowledge as well. (SJD, 1988, p. 1)

More than a decade after that statement, especially after the banking crises, it is exactly the market and the market based measures and terminology that now preoccupy the policy discourse of higher education. Paradoxically, the market discourse within higher education becomes increasingly predominant simultaneously with the broader uncertainties surrounding the Euro zone - which in the first place appeared to take place because of similar market arrangements. As a result, it appears that some EU decision makers today promote a distorted appraisal of what universities are for in an endeavor to justify their value exclusively in a one-dimensional relation to economic growth. In this respect the increasing dominance of market ‘solutions’ for the restructuring of academic life and institutions raises major conflicts with the traditional university ethos in terms of contribution towards the intellectual, scientific and humanising dimensions, as vital outcomes of higher education. Discussing the instrumental tendencies surrounding the university in the UK, Collini makes a similar point, arguing that universities at present

> *…have a fatal tendency to fall into this kind of corporate boiler-plate, with traditional phrases about 'the pursuit of truth' or 'the cultivation of mind' now being jostled aside by more recently minted clichés about contribution to the knowledge-economy. (Collini, 2012: 89)*

Returning to the – in many respects criticised - Bologna Declaration (1999), it is important to highlight the fact that it explicitly refers to the fundamental higher education principles laid down in the Magna Charta Universitatum and reinforces the same 'open-ended - commitment to knowledge, where universities are seen as central to the cultural, social and scientific progression of Europe. In this regard, "a Europe of Knowledge" (1) in the Bologna Declaration was defined in considerably wider terms than the predominant instrumental understanding of the phrase today.

Much of Bologna's potential and commitment towards the creation of a coherent European Higher Education Area was used later in a broader context by the EU - alongside the creation of the Euro - as an instrument towards the creation of a unified European family. In this sense the Bologna process "has become one of the most powerful symbols of 'European-ness'" (Scott, 2012: 1), where despite some differences, it is increasingly relevant to discuss in terms of a shared rather than separate Bologna-Lisbon process.

Under the Lisbon influence it is thus possible to identify a shift from a Europe of Knowledge towards a Europe seen as a 'knowledge society', where the later knowledge extends (or should extend) to operate – as Gibbons et al. (1994) would suggest (though they do not use the term 'knowledge society' but instead 'reflexivity') – in a context of application. In this sense, knowledge becomes (or should become) more reflexive and has been given "a context in which and on which it can act" (Gibbons et al., 1994: 103); thus, it is increasingly influenced by wider social concerns.

However, the term knowledge society in the EU policy documents is almost immediately replaced, or more probably wrongly identified, to explain the transition towards the so-called knowledge-based economy. Despite some significant similarities between the knowledge society and the knowledge-based economy concepts, a diverse group of commentators, in my judgment rightly, suggest that these concepts are far from identical (Rooney et al., 2003). Though overlapping in various ways, Rooney et al. suggest that a key difference between the two is that " a knowledge society is a broader term than knowledge economy or knowledge-based economy in that it encompasses more intellectual activity than narrow economics, commercial and industrial concern" (2003: 16).

These criticisms relate to a deeper set of concerns suggesting more generally that concepts such as the knowledge economy and the knowledge society are partial and ill-defined; so that a clear distinction between the two concepts has proven to be highly problematic to make (Smith, 2002). As Peter Scott very importantly suggests, “the closer we approach to a ‘knowledge society’, the more diffuse becomes our notions of what counts as 'knowledge' and the more problematical, even precarious, becomes the status of traditional 'knowledge'” (Scott, 1997: 1).

In this respect, somewhat paradoxically, it is precisely the ambiguity of ‘knowledge’ that has facilitated the shift towards ever-stronger instrumental uses of the term. Thus, within the EU framework, knowledge has been to a large extent shifted away from the initial wider and more educationally defensible characterisation, and increasingly restricted to the rather narrow but eye-catching instrumental economic conception.

5 Conclusions

In this text I analysed a number of forces promoting radical change within European higher education. Firstly, I discussed the (inappropriate) use of the 1960s Human Capital Theory which has served as a key justification for the later all-embracing but in fact partially applicable concept of the knowledge economy, underpinning much of EU higher education policies at present. In this respect, I suggested that the EU has opportunistically over-emphasised the assumptions about the knowledge economy and its holistic outreach, so to legitimise policies framed within a wider neo-liberal ethos.

Subsequently, I have suggested, by contrasting various policy documents with one another, that the language used to articulate what is of value for the university in the past, has been very different from the overwhelming accent on its economic role today; promoting a distorted appraisal of what universities are for in an endeavor to justify their value almost exclusively in a one-dimensional relation to economic growth – itself considered as unproblematically desirable.

Thus, in my judgment in the future it is relevant to suspect and question the ambition, proportion and appropriateness of new modalities such as the knowledge-based economy when applied to such a unique public institution as the university. Yet, this is not to argue that the economic thinking is completely needless or redundant. In many ways as I have suggested it is pretty evident that for some science disciplines the knowledge-based economy has become (and should stay in the future) indispensible.

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Are The European UBC Models Transferable To The Asian Single-Party States? A Case Of China

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Abstract

The context of university-business cooperation in Europe is changing rapidly. Universities are faced with a globalized society that is increasingly virtual, vibrant and ever changing. In many countries, governments are encouraging public-private partnerships and other forms of collaboration among academia, business and government, and lately also with the civil society. How can we best study these relations?

A traditional triple-helix model cannot capture all of the nuances of the new European experiences. A quatraplex model that includes a civil society is proposed as an analytical tool for studying interactions among the four spheres in Western democracies. Although elements of both models can be found in China, neither one of them is useful for studying university-business-government (UBG) relationships in the Chinese one-party system that lacks a fully developed market economy and the civil society. Instead, a Z-model is conceptualized to help researchers understand the Chinese UBG collaboration that has its roots in the economic development zones. Based on the literature review and interviews, it is concluded that the nature of political systems is an important factor conditioning the development of UBG cooperation. Although similarities exist between Scandinavian and Chinese UBG collaboration practices today, the nature of China's political system reduces its ability to derive full benefits of such cooperation.

Keywords

UBC, model building, China, triple helix, Z-model, civil society.

1 Introduction

We are witnessing the re-emergence of a new interplay between the state, business, civil society and academia on a global scale. In part this is caused by globalization and the realization that the classical model of government-led governance does not work in the face of global challenges, such as the environmental degradation. Aware of the costs and benefits of globalization and new forms of international collaboration, especially as they pertain to economic development and scientific recovery, the institutes of higher education are changing their roles and becoming increasingly more active participants on a world stage where collaborative relationships are emerging across borders among universities, research centres, businesses, civil society organizations, and supranational public entities.

This paper discusses European university-business collaboration within the context of triple helix and quadraplex models, concluding that even within the European Union, different types of UBC practices co-exist and studying them within the framework of the traditional triple-helix model leaves new power players such as civil society organizations, with little attention. The model that includes the civil society is introduced and it is termed a ‘quadraplex’ a word that in the real estate business refers to a building divided into four self-contained residencies. Although applying these models is tempting for studying UBG collaboration in Asian one-party systems, their value is limited. In search of a better tool for systematic observation of China’s UBG cooperation, its long lasting experimentation with economic development zones was studied. Based on this research and the review of official approach to the actors of the emerging civil society in China, a Z–model was conceptualized to help organize and analyse the increasingly complex web of relations among the academia, commercial enterprises, party-state and increasing number of non-governmental organizations in China.

In spite of their limitations, models are useful tools for highlighting differences between various political, social and economic systems, and the modes of cooperation taking place within them. In the following, the Finnish UBG cooperation model is discussed as a case study and the triple helix practices in Finland are compared with those that exist in China. It is noted that in Finland, the triple helix system has a noticeable government imprint, and similarities between its triple helix practices and those of certain localities in China are recognized. However, the comparison also shows that transferring the Western triple helix model to explain UBG relations in Asian single party states is replete with analytical hazards that stem from the systemic differences between Western democracies and the Asian one-party states.

Comparing Western and Chinese UBG cooperation within the triple helix model reveals interesting differences between the two systems but provides only a partial snapshot of the web of relations existing in China. Applying the quatraplex model, on the other hand, for studying cooperation patterns in China is not rewarding at this stage of their political and economic development because the model assumes the presence of a civil society and a free market economy that are both lacking in the country. However, having the quadraplex model in the mix of concepts even when studying authoritarian states is not without merits. In China, citizen organizations are gaining strength and in oth countries the governments are recognizing their value in sharing the responsibilities of governance. Thus, the contours of the relationships the quadraplex model is designed to explain are beginning to form in the Asian single-party states suggesting new dimensions to the Z-model development.

2 Methodology

The research methods include an extensive literature analysis of the key concepts used in the paper, interview-based case studies, and a literature review on the theory and practice of university-business cooperation in Europe and China. The author has also used insights she has obtained from practical triple helix activities while working as an employee of an institute of higher education managing a project, partly funded by the

European Union, that aims at helping small- and medium-sized enterprises (SMEs) enter the Chinese markets. The anecdotal data pertaining to the research questions has derived from this experience. Before and during the project, the author has also travelled to China with entrepreneurs and public officials to meet their Chinese counterparts and has visited industrial sites, power plants, science parks and economic development zones.

3 The key concepts

University-business cooperation at local and international levels does not exist in a vacuum but rather in a context of globalization. In this paper, 'globalization' is understood as constituting a: "multiplicity of linkages and interconnections that transcend the nation states (and by implication the societies) which make up the modern world system. It defines a process through which events, decisions and activities in one part of the world can come to have a significant consequence for individuals and communities in quite distant parts of the globe" (McGrew, 1990). Traditionally, globalization has been discussed with reference to the diminishing role of nation-states, and consequently, seen as leading to the decreased level of decision-making authority at national and local levels.

The term 'globalized society', on the contrary, connotes the emergence of a newly empowered global society that operates using sophisticated modes of communication that can both transcend and modify value systems, and also mobilize a great number of people simultaneously for or against an idea, item, action, decision, value-system or cultural phenomenon. To simplify, in this context a 'globalized society' is a global civil society empowered by communications technology. The industries that are most intimately associated with globalized society are the so-called knowledge-intensive firms (KIFs), such as accounting firms, computer consulting services and high-tech companies.

There has been decades of debate in academic circles about the meaning of 'civil society' that we cannot address here. For the purpose of this paper however, the rich content of the concept is simplified and the term is used to refer to the 'third sector', as distinct from government and business. Thus, the notion of civil society is understood as referring to intermediary institutions such as associations, religious organizations and advocacy groups that are independent of the state.

In conceptualizations of civil society, academia is often considered to be a part of civil society. In many European countries however, institutes of higher education have been heavily subsidized and governed by the states, compromising their autonomy. In recent years though, many European universities have witnessed diminishing amounts of subsidies, leading them to redefine their roles and relationships vis-à-vis the state. In spite of this, in most European countries, the institutes of higher learning are still very close to the state, unlike in the United States where the Department of Education has far less authority than the national ministries of education do in Europe. In this essay, academia is treated as an entity of its own, apart from the civil society.

3.1 The Triple Helix concept

The tripe helix model is a conceptual framework for studying UBG cooperation. It "denotes the university-industry-government relationship as one of relatively equal, yet interdependent, institutional spheres which overlap and take the role of the other" (Etzkowitz, 2002). It is often used with the assumption that such collaboration is a good precondition for fostering innovation and contributing to regional and national development. It is also believed to boosts students' future employment prospects. The concept arose from analysis of university-industry cooperation, and the understanding that the government was an essential part of the innovation equation (Etzkowitz, 2007).

Different types of triple-helix relationships were subsequently discovered, such as the university-led triple helix type that exists in the United States, where the government has a limited role by both law and tradition in directing industrial policies. The second major type is government-pulled triple helix in which the state encompasses academia and industry, and directs the relations between them. This type has made its way to China where universities started to engage in regional economic development on a noticeable scale only after the National Conference of Science and technology in 2006 (Etzkowitz, 2007). The Finnish model of UBC may resemble the government-pulled triple helix model in many respects but closer examination shows that unlike China, in Finland, government-business alliances and business-to-business cooperation have been entirely voluntary.

3.2 The Quadraplex Model

Over the past ten years, various researchers have been redefining the triple helix model. Discussions started at the 2002 Triple Helix Conference in Copenhagen where Loet Leydesdorff and Henry Etzkowitz presented a paper: "Can the 'public' be considered as a fourth helix in University-Industry-Government relations?" (Leydesdorff & Etzkowitz, 2003). More models have been proposed since then (Etzkowitz, 2007). The impetus for redefining of the model originated from the realization that the industry-academia-government relationships have taken different forms over the years. For instance, joint planning and contributions from academia and business to the public-private partnerships in the area of development assistance have been on the rise. These relatively new forms of partnerships have been seen as an opportunity for government assistance agencies to leverage resources and mobilize industry expertise and other networks. Many of these partnerships have included non-governmental organizations and other actors of civil society right from the start.

A quatraplex model includes a civil society as a 'forth element' to be used in analyses of university-business-government cooperation. Its use is justified by new demands of a globalized society to solve both national and global issues through inclusive collaboration that relies increasingly more on the products of knowledge economies and new communications technologies. At the practical level, the quatraplex model serves as a frame of reference for studying non-governmental organizations and their relationship to the institutes of higher education and public entities.

4 Cooperation of HEIs with businesses and NGOs

To understand the reasons behind the increase in a number of partnerships that have been formed between the institutes of higher learning and civil society organizations, a brief look at the recent history of higher education institutions (HEIs) is in place. In the past, HEIs performed duals roles of teaching and conducting research. When discoveries were made using public funds in HEIs, it was left for the commercial sector to develop the innovations, scale then up, market them, and finally sell them to the marketplace. This model no longer provides the returns expected. With globalization, old roles are changing and recent economic downturns in Europe and the United States have accelerated such change. In many countries the governments are encouraging public-private partnerships and other forms of collaboration between the academia, business and government, and lately also with the civil society.

HEIs have also moved closer to the world of business developing better capabilities to cooperate with companies and NGOs involved in programs with commercial applications. Developing these skills are dictated by economic necessities. The institutes of higher learning are faced with challenges posed by new economic responsibilities they have had to assume as governments have reduced their funding. As a result, they are now adapting a market-style organization and learning the art of the commercialization of education services. Although this has generated a greater understanding in academia towards the world of business, it has not turned the personnel at HEIs into skilled businessmen and –women. Besides, there is still little staff mobility between academia and industry and as a consequence, those who have professional competence in both sectors are very few, save for the top business schools.

HEIs need for cooperating more closely with civil society organizations and businesses is enhanced by the fact that they are faced with a globalized society that is vibrant and ever changing. This in itself poses a major challenge to those institutions of higher education wanting to play an important role in the global economy and globalized society. They will have to engage in a variety of cutting edge international activities such as building communities worldwide with the help of modern tools, which include social media. In addition, the internationalization of higher education is placing increasingly more pressure on universities, colleges, polytechnics and engineering schools to continually reform their curricula to reflect the needs of knowledge societies. Such societies are global and require a sophisticated means of management. Because they are intimately linked with the business world, they also require institutes of higher education to increase, develop and upgrade their university-business partnerships.

Because of the changes taking place in the institutes of higher learning, the relationships these institutions have with the business world are changing. We see increasingly more university-business cooperation on a global scale, involving businesses, universities and research institutes from more than one country. A 2009 study commissioned by the European Commission found that about one in four globally active SMEs collaborated with research organizations located outside of the EU. The same share (24%) was also engaged in collaboration with public sector organizations located outside of the EU (Stanoevska-Slabeva , et all., July 2009). Such triple helix relationships, when they originate within the business or academia, do not generally raise objections. However, when the initiating and managing entity of the UBC in one country is a government of a different country, then various legal and moral issues may come to the fore. It is also worth noting that outside the sphere of international development and special situations, such as post-war development, governments rarely engage in cooperation with a triple helix relationship that exists in a foreign country, bypassing their own HEIs and businesses while doing so.

In Western democracies institutes of higher learning are upgrading their cooperation methods with NGOs and companies. In doing so, they operate within the context of a free market economy, the rule of law, and the established independent civil society. Their operating environment is changing rapidly and HEIs are facing new challenges caused in part by their increasingly more active participation in a globalized society. Consequently, the net of relationships that they are forging with NGOs and businesses is in a state of flux. Against this background, it would be difficult to see much value in transferring Western UBC models to Asian one-party systems, including China. This does not, however, preclude sharing of old and new methods of collaboration with them.

5 The Finnish UBC model

From the Chinese point of view, a search for methods and models of collaboration among the public, semi-public and private entities can be frustrating because of the enormous size of the country and a lack of examples of best practices that have successfully operated in the context of one –party authoritarian regimes. But there are some interesting cases to consider. The Nordic countries have traditionally had a larger government sector and higher social expenditures than the continental economies. Their commitment to the universalist welfare state combined with their long history of brokering partnership arrangements between employers, trade unions and the government make them conceptually interesting to Chinese social scientists and government officials alike. In addition, they are innovative and technologically advanced. What particular methods in their experience would be especially worth considering?

Finland is one of the most competitive and technologically advanced countries in the world. In the World Economic Forum's (WEF) competitiveness survey for 2010-11, the country ranked among the top three countries in the world for its ability to utilize technology; number one in the top countries in innovation; number one in terms of higher education and the availability of engineers and scientists; and it led the other Nordic countries in patenting (World Economic Forum, 2010). Yet, at the beginning of the 20th century, it was one of the poorest in Western Europe. This remarkable growth, especially in the past twenty years, has been attributed to Finland's model of economic development that has incorporated the triple-helix principle since the mid-1980s (Andersson, April 2010).

When explaining the reasons for Finland's successful transition to the knowledge-intensive industrial structure, Thomas Andersson notes that there was no underlying master plan. The government did, however, view the concept of a national innovation system and industrial clusters as its fundamental policy outline and assumed the role of the facilitator and coordinator in its attempts to raise innovation and economic growth. In his view, the 'Finnish model' is based on the acknowledgement of importance of the interdependencies existing between research organizations, universities, companies and industries as a consequence of using knowledge as a competitive advantage.

Public-private partnerships are well integrated into the Finnish research system, too. The goal is to improve the relevance of basic and applied research and to focus scarce national resources on the topics that promise the highest payoff in terms of science and commercialization. The Academy of Finland is a key entity in the National Innovation System (NIS) and has consistently strengthened national and international cooperation through research programs. Its aim has been to promote interaction between basic and applied research and between technology and product development. In addition to the Academy of Finland, there are a host of different public, semi-public and private organizations involved in the NIS. Among them are Finnish science parks that have been established in a close proximity to the universities with the purpose of creating strong knowledge and innovation clusters.

The Finnish model operates within the framework provided by the European Union. The EU has become increasingly vocal in its support of university-business collaboration. In 2006, the EU Commission identified six challenges to be addressed in relation to university-business collaboration at the European level. These included: new curricula for employability; fostering entrepreneurship; knowledge transfer; mobility across borders and between business and academia; opening up universities for lifelong learning; and better university governance. While these challenges are being addressed and new approaches being developed and perfected, European universities are soon in a position of providing examples of their best practices to Asian single-party states.

The Nordic countries can offer the Chinese some insights into the workings of their partnership arrangements in the areas of scientific research and university-business-government-civil society cooperation. They can also share their experiences in creating and managing a system of industrial clusters. Finally, they have a valuable history of operating welfare services that are inclusive, benefitting all members of their societies, including the senior citizens. But they cannot be useful in helping the Chinese to boost innovation in the absence of individual freedoms, an independent civil society, and the free market economy.

6 The conditions for UBG cooperation in China

The nature of political systems is an important factor conditioning the development of tripe helix and quatraplex relationships. Modern university-business cooperation takes place within a variety of different political, social and economic settings. In the United States, a pluralistic liberal-democratic system and a free market economy flourish. Europe is known for having liberal-democratic welfare states, especially in the North. In addition, there are transitional countries, such as Russia, and authoritarian single-party systems such as China and Vietnam.

The reason why China may benefit from the European experience in defining its own triple helix relationships rather than by the American experience stems from the similarities of their stated goals, implying that Chinese leaders desire to embrace some of the values that underlie the European system. What are these values and principles? Well, Karl Aiginger and Alois Guger talk about the European 'socio-economic model' noting that its essential feature is the responsibility of society for the welfare of the individual. The European model has two additional characteristics: regulation and redistribution. Regulation refers to the regulation of labor and product markets and redistribution refers to the leveling out of income differences between the rich and poor through taxes and transfers (Aiginger and Guger, 2008). Such leveling is one of the key goals of China's 12th Five-Year Year Plan.

China's transition from a planned economy to an increasingly more open market economy has succeeded remarkably well if the economic growth rate is used as a yardstick. Today, China is a technology-driven country where indigenous innovation is encouraged, supported, and heavily subsidized. But the country is still an authoritarian state without a market economy and a civil society. Because of this, using the triple helix model as we have applied it in Western democracies for analyzing China's UB relations would not work without major modifications. Applying the quatraplex model that allows for a major role for autonomous civil society organizations is unrealistic unless the country undergoes major systemic reforms. However, there are elements of a market economy and also a civil society present in China and their role in the future is likely to increase. China, like many other countries around the world, is also reaching out to its citizen organizations asking for their help in managing some of its core tasks, such as senior care and environmental cleanup.

6.1 Challenges posed by the economic system

To better understand the challenges university-business cooperation faces in China, one has to start by analyzing both the economic and educational system of the country. To make sense of the Chinese economic system in a way that helps us understand the free market activity that we witness there, it is useful to conceptualize China as a country where three submarkets exists: (1) the Controlled Market; (2) the Dominated Market; and (3) the Free Market. In the Controlled Market that covers such industries as telecommunications and strategic technical research, the party-state makes all major economic and operational decisions but may allow aspects of a free market economy to coexist. In the Dominated Market, state-owned enterprises (SOEs) exercise control over such segments of the economy as energy production and transportation. The last subsegment of the Chinese economy is the Free Market where most successful deals are made for the most number of Western companies. This market is characterized by manufacturing goods for export; light industry; local markets that are associated with production of luxury goods and technically advanced products; real estate; and parts of the service industry (Oksanen, 2011).

Conceptualizing the Chinese market place with reference to its submarkets with different degrees of state control, leads us to conclude that studying the free market segment is the right place to start for analyzing university-business-government relations in China. This assumption will however, have to be scrutinized. Difficulties arise because there is still little information concerning the main players of the free market. Taking the number of entrepreneurs as an example: we don’t know the real numbers, although we know that the Chinese free market segment is truly vital. Yashen Huang, Professor at MIT's Sloan School argues that Western economists don't understand the real ownership structure of the Chinese company. He claims that the way private ownership laws, finance, and the industrial landscape of China are currently set up, makes enterprise nearly impossible. He goes on by saying that China’s laws are set up to discourage private domestic entrepreneurs from succeeding. Shanghai is affluent not because its private sector is big, but because China entrepreneurs set up their corporate headquarters in the tax and regulation haven of Hong Kong and merely outsource their business to Shanghai (Elbot, 2012).

The Chinese economy is complex consisting of different players. The state owned enterprises (SOEs) have extraordinary economic and political clout. In 2010, the SOEs made a combined net profit of 849 billion Chinese yuan (almost 100 billion euros). In 2009, their combined assets of 21 trillion yuan ($3.17 trillion) accounted for 61.7 percent of the country’s GDP (Lam, 2011).

There are several major problems with the SOEs economic influence from the point of view of the private market segment. Most importantly however, by allowing SOEs to have such an influential role in China, the government has obstructed market forces. By reinforcing rules and laws selectively in favor of SOEs, the government has deprived genuinely independent firms of resources, such as credit and labor. As a result, independent companies are starved of formal credit forcing many of them to rely on China's shadow banking system. In addition, many knowledge-intensive firms that have grown from privately owned start-ups, face intense labor market competition from SOEs. The research funding within the Chinese innovative system also favors SOEs at the expense of private companies.

6.2 Socio-political reforms

The university-business collaboration is China is managed by the state through its extensive innovation system, consisting of science parks, high-tech parks, universities, state-owned companies, research laboratories and the like. The whole system is well funded. Ingenious innovation is not, however, bringing the results expected and university-business collaboration remains poorly developed. State-owned enterprises struggle to translate scientific discoveries into successful products. How much of this is caused by inbuilt weaknesses of the authoritarian system? Will the Chinese respond by adopting fundamental reforms?

Systemic changes are already taking place and they will eventually change the conditions in which a more flexible, fluent, and productive university-business collaboration may take place. Most importantly, the free market segment of the Chinese economic system is getting bigger at the expense of the Controlled and the Dominated markets. Especially encouraging is the increase in the number of privately owned businesses. In fact, by 2007, China had 42 million SMEs defined as businesses that retained between 400 and 3000 employees. These companies accounted for 99.7 percent of the total number of enterprises in the country (Hilgers, 2009). In the mid-1990s, the government set up a SME department in the State Economics and Trade Commission and in 2002 enacted the SME Promotion Law to advance the fair treatment of small and medium-sized companies. Since then, the number of new policies and opportunities for SMEs has multiplied, making them important players in the Chinese economy.

The second major change that will have an impact on university-business-government collaboration and eventually pave a way to cooperation within the quadraplex model is the emergence of a civil society. In fact, the civil society in China has been evolving for the past 15 years. According to Professor Wang Ming of the Tsinghua University NGO Research Centre, there are between three and four million civil society groups or ‘people’s sphere organizations’, in China already, far more than the Ministry of Civil Affairs suggested in 2010 when it estimated their number to be around 400,000. The reason many groups don’t register is that the registration requirements are too onerous for them. In addition, there is an uneasy relationship between citizen groups and the government authorities in China. In recent years, the government has seen the value of incorporating many of the citizen groups in managing its own tasks at the local level, but at the same time it has been fearful of seeing such groups becoming empowered. The role of civil society in the transitions to democracy of the Communist countries after the collapse of the Soviet Union is still fresh in their minds.

The third major change that has taken place over the last 20 years is an attempt to form more international relationships, some of which include the academia-industry-government partnerships in China and triple helix partners in a foreign country. But there is still tension between the parties in this net of relationships. Western firms who have entered into technology partnerships with Chinese government companies, have often done so reluctantly. They believe in open markets and frown upon the Chinese view that the technology transfer that often comes with such partnerships is a 'fee' for the market access they get in return. There are, however, also those Western firms that gladly accept the generous grants, facilities or other perks that come with partnership deals in many provinces of China.

6.3 Why are new UBG models needed for studying one-party systems?

The triple helix model was developed with Western democracies in mind, although in some democracies, the public and private spheres have been further apart than in others. In the United States, the state-business relationship has traditionally been weak and neither the federal or state governments have been expected to play an important part in the economic development. This changed with the introduction of the New Deal and today the government at all levels enters into partnerships with entities belonging to the private sector. In the United States however, the firewall between these spheres is more pronounced than it is in the European countries, especially in the Northern European welfare states.

Contrary to this, in China, the Communist Party has been in charge of economic development through the offices of the state. On-going reform is, however, forging a wedge between the spheres. In the language of the triple helix model, the helices of government and business on one hand and those of the government and academy on the other are being separated in a controlled fashion. For instance, the central government has reduced the number of state-owned enterprises (SOEs) from 196 to 121 in the past five years and aims at reducing their number further to 30-50. In so doing, it is purposefully relinquishing some of its economic power.

In light of the rather fundamental reforms taking place in China, it is tempting to describe Chinese university-business-government (UBG) cooperation in terms of the triple helix model. In the opinion of this author, transferring the triple helix to China or other single party systems does not, however, serve the students of the UBG cooperation well. The model is based on certain assumptions, such as the presence of a civil society and free market that do not exist in China. In addition, the concept is too well embedded in the consciousness of Western social scientists for it to shed its cultural, political and economic connotations. Even with modifications, the term would cause conceptual confusion.

7 The Z-Model

Instead of trying to apply a Western-made triple helix model in the study of UBG relations in China, such research may benefit from using ideas and concepts that stem from the Chinese political, economic and social discourses. For several decades, one of the central themes has been the idea of zones. The Chinese have set up economic zones within which market reforms have been tested and cooperative clusters between public and private entities formed. The zone model can be extended from the Chinese experience for analyzing the UBG relations in a country where there is a single party in power, a weak civil society, dependent institutes of higher learning, centrally controlled media, and several markets within the economic systems of which, the most important is that which is under government control.

The zone model has its roots in the development of cooperation among the functionally different spheres of the Chinese party-state and between the state-led economy and foreign enterprises. The main benefit of using the model from the point of view of the party-state, has been that it allowed the government to focus on a small slice of the economic and later socio-political sphere and test new concepts such as a free market. Developing cooperative relations zone by zone, allowed the party-state to retain control over reforms and help the officials to manage the development in a way that was thought of as beneficial in terms of economic, technical and social returns. It can be argued that this model worked very well for China if the success is measured in terms of the rate of economic growth and social stability.

The first prototypes of such zones (later called ‘special development zones’ - SEZs) were established in the 1970s to attract foreign capital and to allow foreign companies to conduct business outside the bureaucratically cumbersome economy that characterized the rest of the country. The SEZs worked for the benefit of foreign businesses that in return for setting up their operations in the zones, received tax benefits and a right to manufacture their products mainly for export in a relatively liberal environment. The central government, in turn, found SEZs to be useful tools by which to test if the centrally planned economy could transform into a more liberal mode of economic production. In 1984, SEZs were set up in 14 coastal cities, to be followed by 15 free-trade zones, 32 state level economic and technological development zones, and 53 new and high-tech industrial development zones in large and medium-sized cities.

The second major feature in the Chinese Z-model was the centrality of science and technology parks, which became a conduit for collaboration among various industrial sectors in China and between them and foreign enterprises and scientists. The first Chinese science park was launched in 1988 after the Silicon Valley model at Zhongguancun, within the Beijing Experimental Zone. By 1995, there were 52 Chinese national science parks, and another 31 regional innovation centers. By the end of the 1990s, there were 2.21 million people working in 17,498 high technology firms situated within 53 national science parks. Of these, 670,000 were researchers and engineers, 5,300 with PhDs and 38,000 with master's degrees (Macdonald and Deng)

The numbers are impressive, but in terms of what was expected of them in the field of innovation, it is far from clear that they have achieved their objectives. According to an observer, many high-tech parks in China are little more than assembly lines.

The third feature and one that is currently getting more attention is the cluster approach to technical and scientific development. Cluster thinking became more popular after the central government outlined strategic tasks for building an innovation-oriented country. This led to the cluster developments in the Beijing, Shanghai, Shenzhen, Xi'an and Chengdu High and New-tech Development zones. To enhance their capacities for innovation, scholars and government officials are now calling for local actors in China to create a 'network of sophisticated, interdependent linkages' to boost innovation. Notably, the participation of small and medium-sized enterprises, many of which may be considered as genuinely private, is encouraged.

The movement from parks to clusters within the zone model is an expression of the government's desire to encourage the birth of new companies. By calling for the creation of local innovation clusters, Chinese academy officials are preparing conditions for increased inclusion of citizen organizations and private companies in the path of economic and social development. As Professor Wang Jici from Peking University has observed, innovation is considered as an interactive, cumulative and social process as professor Wang Jici from Peking University has observed (Wang Jici). Today there are many academic clusters that support industries. Among them are clusters in engineering, banking and finance, information technology, chemical and pharmaceuticals, foreign languages, political science and law, economics and business management.

Zone thinking also applies in the management of government relations with citizen organizations. The Chinese government has supported the work of nongovernmental organizations to fight HIV/AIDS in the country since 2006, but it has always had an uneasy relationship with NGOs. There is however a change taking place in this respect, too. Lately the government has expressed its recognition of the work that NGOs have performed in China. In his speech at the 2012 New Year Reception for NGOs (available at the Ministry of Foreign Affairs website), Vice Foreign Minister Cheng Guoping noted that NGOs have been 'playing an indispensable and unique role in providing social services and promoting programs for public good'. In the same speech, however, Cheng Guoping expressed an official adherence to zone thinking by noting that the areas in which the Chinese would welcome foreign NGOs to take interest in are those of poverty reduction, disaster relief, environmental protection, education, medical care and charity. By selecting certain areas and not all, the government allows freedom for

NGOs to operate under the restrictive Chinese laws it deems suitable for the related segments of the socio-political regime. As such, the Z-model works well for countries that are authoritarian and in a transitional phase

8 Conclusions

Universities and businesses have been collaborating for over a century, but their interactions have become more frequent, especially in the wake of globalization and the rise of a globalized society. The networks of relationships that the quadraplex model seeks to explain have also risen in part because of the emphasis given to partnerships among the various states, businesses and organizations of civil society in solving global problems. A proof of such an upsurge of interest is the plethora of new organizations that are acting as platforms through which the government, commercial enterprises, non-governmental entities, institutes of higher learning and scientific institutes try to cooperate. Many of these inclusive platforms are geared at providing social goods, such as a clean environment.

Globalization has introduced an increasingly important international dimension to the triple helix and quadraplex relationships and, consequently, will transform their associated models. Alliances across functional spheres and boarders can easily be formed for temporary or lasting purposes. Today, we can even see a set of triple helix relationships in one country, uniting with a set of triple helix relationships. Such arrangements are already common in the area of development aid. Government development assistance agencies and departments as well as supra-national entities, such as the World Bank or the United Nations, are working with private sector entities in unprecedented ways. Explaining similarities and differences between such networks across the cultural, political and economic divides will expand our horizons on the opportunities and methods of cooperation.

In this paper, an attempt was made to compare the economic systems and social conditions that are conducive for the creation and maintenance of triple helix relationships in Western democracies and one-party authoritarian systems in Asia. The main differences of the two cases concern their cultures and political systems on one hand and the tradition of interaction between the public and private spheres on the other. The poorly developed civil society and the authoritarian one-party political system in China conditions the way in which relationships between the government, academia and the business develop. In one-party systems, the state determines the degree of autonomy that academia and the world of enterprise enjoys and because of this, the triple helix model as it is used in the West cannot be directly applied to explain triple helix relationships in China.

The UBC field in Europe is changing rapidly. There is no one triple-helix model that can capture all of the nuances of the European experiences. Instead, there are many variations of the triple helix model. In addition, there are networks of relationships that can also be described within the framework of the quatraplex model that includes the civil society as an important part. These relationships are, however, in a state of constant flux. Such fluidity is an additional reason why transferring the Western UBC models to China is difficult. But it is far from clear that such transfers are even necessary for Chinese social scientists to explore their own UBG relations. As has been shown in this paper, the Chinese have ingredients in their own history of collaboration among research institutes, universities, enterprises and government agencies that provide a good basis for building a model within which these relationships can be systematically examined. Such models could help social scientists interested in other one-party states to conduct research and derive conclusions that can contribute to the study of partnership building not only within these countries but also across the boarders.

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Fostering Innovation And Entrepreneurship Through Joint Initiatives With Industry

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Abstract

In 2010 the Cyprus University of Technology set nine strategic goals until 2020. One of these is the linkage with the productive fabric of the country. Various steps have since been taken towards the achievement of this strategic goal focusing on fostering innovation and entrepreneurship through joint initiatives with industry and the business world. The paper examines these initiatives in the broader context of the University's mission as a catalyst for change and growth in its region that engages actively in the educational and cultural life of its community.

Keywords

Innovation, university-industry initiatives, entrepreneurship, Cyprus University of Technology.

1 Introduction

The Cyprus University of Technology (CUT) is a new state University in Cyprus. It admitted its first students in 2007. Currently it has 2500 students, it offers programs of study at all cycles (undergraduate, Masters, PhD), and has graduated about 700 students, including 8 doctoral students from four disciplines (Civil Engineering, Mechanical Engineering, Nursing, Environmental Science and Technology). At present, the University has 226 positions for teaching and research staff and currently employs roughly the same number of administrative staff.

CUT is an urban university, growing within and around the historical center of the old city of Limassol, making this region the focal point for its activities. The University aims to be an integral component of its local community and has already developed various initiatives for strongly engaging in the educational and cultural life of its community. By renovating historical buildings and using them for housing some of its key functions (library, main lecture hall, Senate house) the University is contributing in a major way towards maintaining the cultural heritage of the local community.

The University has signed protocols of collaboration with a number of municipalities in its immediate and broader region, symbolically starting with the Municipality of Limassol. The collaborative activities listed in these protocols include research, educational and cultural activities, and have already been inaugurated through series of public talks on scientific and other matters of broader interest, joint projects, and other joint initiatives, such as EuropeDirect that started its operation this year. Protocols of collaboration have also been signed with many other stakeholders including the Ministries of Commerce and Industry, and Communications and Works, the Cyprus Telecommunications Authority, the Cyprus Tourist Organization and the Federation of Employers and Industrialists.

The University's "Strategic Plan 2010-2020" (CUT, 2010) that was formulated in 2010 following extensive internal dialogue and exchanges with external stakeholders, reaffirms the vision of the University as "a modern and innovative university with international recognition, capable of providing high quality education and research in cutting-edge areas with scientific, technological and economic impact, and assisting society in addressing important problems in these areas" and sets targets for realizing this vision, firmly positioning the mission of the University under the quadruple: (a) Education, (b) Research, (c) Linkage with the productive fabric of the country, and (d) Engaging with society.

Overall, nine strategic goal areas are included in the University's Strategic Plan 2010-2020, namely:

(1) education

(2) research

(3) linkage with the productive fabric of the country

(4) internationalization

(5) infrastructures in facilities and equipment

(6) administrative support and infrastructures

(7) quality assurance and internal quality culture

(8) service to society, and

(9) student welfare

Each area is analyzed into hierarchies of priorities and key indicators for measuring and monitoring performance towards their attainment. The strategic plan underlines the University's development during the current decade, encompassing important trends and developments at European and international levels. Its aim is to turn CUT into a modern technological university that promotes excellence in teaching and research, that has a major impact in the socio-economic development of its region, and that actively engages in the educational and cultural life of its community. In this paper we examine the steps that are being taken towards the strategic goal of linking CUT with the productive fabric of the country, focusing on actions fostering innovation and entrepreneurship through joint initiatives with industry, the business world and other stakeholders (municipalities, public and private authorities). Through these initiatives the University aspires to be both a catalyst and a driving force for change and growth in its region. In addition, due to the financial crisis and the various austerity measures imposed, CUT has seen its annual state budget for 2012 and 2013, drop to about 40 million euro from the roughly 70 million euro that it was in 2010 and 2011. This drastic reduction of over 40% to the University's state budget, calls for revenue generation through other means. Innovation and entrepreneurship through joint initiatives with external stakeholders, principally industry and business, are the way forward towards higher financial autonomy for the University.

2 Joint initiatives with industry

The following initiatives are underway for meeting the aforementioned strategic goal:

(1) The University runs a Liaison Office with Industry utilizing structural funds. Similar offices operate in other five universities in Cyprus with the objective of connecting the academic world with the business world. The CUT office was the first to start its operation. So far it has created a registry of in-house scientific/technical expertise, it aids academic departments in placing their students in industry for internships and it participates in setting up a registry of local SMEs and their relevant needs/expertise with a view to establishing partnerships. It is noted that Limassol, the biggest port city in Cyprus, hosts the shipping activity of the island and many offshore companies have their offices in Limassol. In addition, the major pharmaceutical and food and drink industries in Cyprus, with an international portfolio, have their headquarters in Limassol.

(2) Most academic departments of the University have established forums with industry both for student placements in industry as well as for enhancing, through their curricula, the skills and competences that industry needs. It is noted that the academic departments of the University are organized under the six Faculties: Health Sciences, Management and Economics, Engineering and Technology, Arts and Design, Geotechnical Sciences and Environment Management, and Communication and Media. The curricula of the first cycle programs are largely interdisciplinary emphasizing the application of theoretical knowledge to practical problem solving, through case studies, learning by doing, practical/hands-on experience in industry and other forms of experience-led teaching and learning.

(3) In conjunction with the operation of the Liaison Office with Industry, the University Council has appointed a Liaison Committee with Society and tasked it to liaise with social stakeholders (local business, industry, public authorities, etc.) with a view to attracting student scholarships as well as to facilitate the networking between research teams of the University and local SMEs and bigger industries, identifying research-related problems of interest to both parties, that could be tackled through innovative knowledge and tech-

nology transfer. Thus instead of the University waiting for industry and business to approach it, it itself engages in a proactive liaising with them.

(4) Legislation is underway for establishing a Research Institute within the University focusing in the areas of energy (prospects in this area have been substantially enhanced owing to the recent discovery of hydrocarbons in the Exclusive Economic Zone of the island), health, environment and ICT. This is a novel idea, based on the concept of the "knowledge triangle" that underlines the European Institute of Innovation and Technology Knowledge Innovation Communities. The key features of the Research Institute, the establishment of which will substantially increase the organizational autonomy of the University are: (i) a governance structure that involves industry as a key partner, (ii) joint appointments with industry, (iii) provision of graduate level programs (Masters, PhDs) addressing entrepreneurship and experience-led teaching, (iv) endowed chairs from industry, (v) industry collaboration and innovative knowledge transfer acquire prominence in the promotion of the academic staff of the Research Institute, and (vi) the provision of significant incentives to researchers (start-ups, spin-offs, etc.).

(5) The Faculty of Management and Economics plans to start an MBA program in Sept 2013, as a joint program between the two existing academic departments of the Faculty, namely the Department of Commerce, Finance and Shipping, and the Department of Hotel Management and Tourism. The program aims to establish close links with industry and business and the acquisition/enhancement of entrepreneurship and business planning skills constitute a major feature of the program. Structural reforms within the Faculty of Management and Economics are also under discussion, in conjunction with the establishment of a third academic department in line with the objectives of the "Strategic Plan 2010-2020". These structural reforms will aim to further boost the development of an entrepreneurship culture and a risk taking mindset, in the overall context of integrating research, business and innovation.

(6) Various other joint ventures with industry and other stakeholders (cooperatives, local business) aimed to be subsidized by structural and/or private funds, and with the objective of bringing back to use old buildings and other premises, both for housing functions of the University, as well as for generating jobs and revenue, are underway. Such an ongoing project involves the newly established Faculty of Arts and Design and the pursued refurbishment of carob warehouses where various functions could be housed (carob museum utilizing new technologies, design laboratories, gallery, etc.). The particular carob warehouses were built in 1947, they are situated on the seafront, and they form a very interesting complex, architecturally, culturally and educationally. Most importantly this complex has a huge potential with respect to regional development and the exploitation of innovative, entrepreneurial ide-

as. The complex could be the centerfold of the activities of an invigorating Faculty of Art and Design (the only such Faculty in Cyprus) and its two academic departments, in Multimedia and Graphic Art, and in Fine Arts, utilizing new technologies in old settings, and developing the surrounding region to provide the necessary modern facilities for student life and extra-curricular activities. This could be a very exciting project bringing together many stakeholders, and with job creation opportunities.

The rest of the paper is structured as follows: In Sections III and IV we respectively elaborate further on the Liaison Office with Industry and the pursued Research Institute. Finally, the concluding Section V summarizes our findings and results and gives some overall conclusions and recommendations.

3 Liaison Office with industry

The CUT Liaison Office with Industry was formed in February 2011 as a European Social Fund project entitled "Development and Operation of Enterprise Liaison Offices in Universities Operating in the Republic of Cyprus" and has a key role within the University's strategic plan for promoting synergies between industry and academia. Its purpose is to develop a structured network in order to provide the University's academic and student community and the regional business sector a partnering platform enabling both sides to explore effective mechanisms for the transferring of specialised know-how in terms of research, technology and innovation. The specific aims of the Liaison Office are the following:

› To extend networking and partnership implementation opportunities between the University community and the local public and private organisations and enterprises in terms of knowledge transfer and sharing, applied research opportunities and joint research proposals/programs.

› To promote specialised consultancy services from the University to the Industry.

› To provide assistance for spin-off joint ventures creation, patent and copyright management and intellectual property.

› To maximise employment opportunities for students and graduates through a student placement framework in businesses, in fields related to students' education and specialisation.

Task	Total
CUT academic profile records completed	115
CUT laboratory profile records completed	40
Enterprise profile records completed	75
Job positions/placements completed	15
Preparation for commercialisation offers	8

Table 1: Initial results of the Liaison Office with Industry

Since its conception in February 2011, the Liaison Office has generated notable results, as shown in Table 1. More specifically, the Liaison Office has:

(1) Has recorded in detail the profiles for the academic member of staff and of the laboratories of the University and has built a comprehensive database listing the University's competencies, expertise and research results.

(2) Has visited a number of enterprises to record their profiles in order to identify areas where there is scope for collaborations and partnering opportunities in terms of joint research, knowledge transfer and sharing, as well as innovation supply.

(3) Has recorded a number of job positions available in the industry for students of the University and completed a number of placements.

(4) Has formulated matching clusters and knowledge communities within a number of sectors by combining the University's fields of expertise and the local industry's prospects, know-how and needs with the aim to reinforce research partnerships in the areas of innovation and entrepreneurship.

(5) Has initiated and coordinated a number of meetings and information activities with business and non-profit organisations in order to establish closer links and collaborations with the University.

As a result, a number of mutually beneficial links and synergies through research collaborations and partnering opportunities have been developed between the University and a significant number of profit and non-profit organisations.

Overall, CUT has been generating significant results in research and development, in particular in the following areas of expertise:

› Electrical engineering and IT/robotics and molecular informatics

› Mechanical engineering and material science/ nanotechnology

› Civil engineering and geomatics/remote sensing measurements

› Air pollution monitoring

› Renewable intelligent energy and energy conservation/environmental and public health/biotechnology and food science

- Hotel management and tourism/commerce, finance and shipping
- Communication and internet studies/ multimedia and graphic arts

4 The Cut Research Institute

The pursued CUT Research Institute utilizes concepts from the European Institute of Innovation and Technology (EIT) that was founded in 2008 with the aim to enhance sustainable growth and competitiveness in Europe by reinforcing the innovation capacity in the European Union and its member states. Deficiencies that led to the establishment of the EIT were (EIT, 2012): (a) fragmentation of the innovation system, (b) underuse of existing research strengths to generate economic and social value, (c) failure to sustain or renew enterprises (d) lack of an entrepreneurial culture leading to low innovation activity, and (e) poor performance in developing, attracting and retaining talented people.

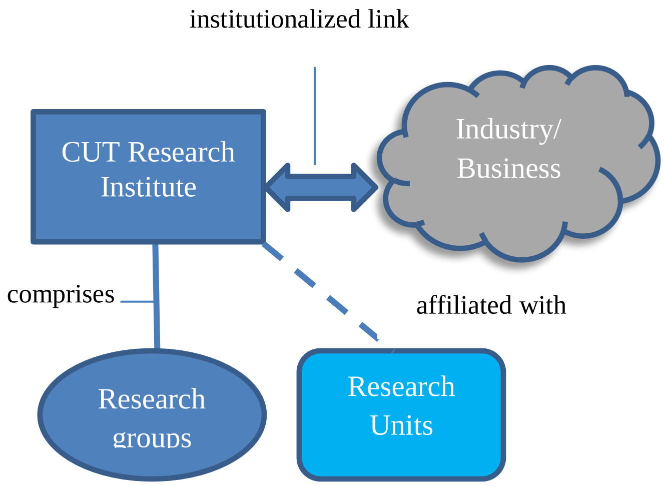

Fig. 1: The CUT Research Institute comprises, in a dynamic fashion, research groups, is affiliated with other Research Units within the University and collaborates with industry through institutionalized links

The EIT aims to catalyze the "knowledge triangle" in Europe, utilizing innovative entrepreneurship for integrating higher education, research and technology, and industry and SMEs. The uniqueness of the EIT lies precisely in connecting all actors of the knowledge triangle in long and concerted efforts, adopting a results-oriented approach and promoting "open innovation" (Chesbrough, Vanhaverbeke and West, 2006; Perkmann and Walsh, 2007). EIT's operation led so far to the deployment, with significant tangible results, of three Knowledge and Innovation Communities (KICs), Inno-Energy, Climate-KIC and EIT ICT Labs, while further KICs are planned, under the "Strategic Innovation Agenda" (European Commission, 2011) which highlights the activities of the EIT for the period 2014-2020, as an integral component of "Horizon 2020" under societal challenges. KICs are the innovation factories of the EIT, and within each KIC, its so-called Co-Location Centers (CLCs) are the innovation hotspots delivering results. EIT's impact is both through the KICs as well as on its own, as a unique Institute for Europe, disseminating good practice in its sphere of activities, and facilitating the creation of the new generation of entrepreneurs in Europe.

Having regard for the above major developments at European level, with respect to the EIT, CUT proceeds to establish its own Research Institute. It is noted that the present organizational structure of the state universities in Cyprus allows for the establishment (through Parliament decrees) of Research Units. However, the notion of a Research Unit is quite restrictive, and it certainly does not allow for those mechanisms that are necessary for the integration of the knowledge triangle. Thus a new concept is called for. The proposal prepared by the Committee on Strategic Planning and Development was recently ratified by the University Senate and Council and the relevant legal framework is presently under development.

The establishment of the proposed Research Institute would help to strengthen the autonomy of the University regarding organizational structure, funding and staff (Estermann and Nokkala, 2009), and in particular it will promote the interconnection of the academic activities of research and graduate education with the productive fabric of the country. The ultimate goal is to create more flexible structures for boosting and promoting scientific research in unison with industry. The new scheme would provide incentives to researchers to be continuously active in research and able to attract external funding for research programs, while educating young researchers through specialized postgraduate programs at Master's and doctoral level, thus acting as a Graduate School as well. It is noted that the academic staff of the Research Institute would receive remuneration from the state budget just for their teaching, but would be able to top up their salaries through research-related and technology transfer activities. Moreover, they would be able to hold joint research appointments with industry. In addition, the promotion criteria for the academic staff of the Research Institute would emphasize knowledge transfer and related societal impact. Overall, the Research Institute would be hosting a number of research groups (that could vary dynamically over time), would be affiliated with other Research Units within the University, and its collaboration with industry and business, through institutionalized links, would constitute an integral aspect of its operation (see Fig. 1). In addition, any researcher within the University whose research results/ideas might have a business/industrial potential and who would like to explore such opportunities, could take advantage of the facilities and knowhow of the Research Institute.

More specifically, the Research Institute is expected to function as a self-financing entity, promoting the following:

(1) The creation and housing under one umbrella, of a critical mass of researchers, most of whom would be full-time researchers, and belonging to various scientific disciplines, thereby promoting interdisciplinary research. These sci-

entific areas would constitute priority areas for the University representing technological frontier areas with significant growth potential, so that it would be feasible to attract substantial private investment for this research.

(2) The linkage between research and the industrial and business world, as well as with organizations of common benefit and NGOs, with the aim of transferring the resulting knowledge and technology to create innovative products and services, thus implementing the concept of the "knowledge triangle" mentioned above. This would be achieved by explicit and interactive, institutionalized links between the Research Institute and industrial/ business units. The mechanisms of innovation are largely common to the various disciplines and therefore the co-location and collaboration of many research groups/units within the Research Institute would lead to more coordinated and rational use of these mechanisms.

(3) The provision of innovative, specialized international graduate programs (Master's degrees and doctoral level programs) in research areas covered by the Institute, thereby directly linking scientific research with advanced postgraduate education, as the new knowledge acquired through research would be transmitted directly to the graduate students. The postgraduate programs in question, beyond the scientific knowledge in their scope, will have reinforced components of "experience-led teaching" (The Royal Academy of Engineering, 2010) through the explicit and interactive interface with industrial and business units mentioned above, and even some of these programs would be joint university-industry programs, for example joint doctoral programs, where students would be funded by industry.

(4) The training of the graduate students and of the researchers of the Institute in developing the necessary transferable skills with a focus on entrepreneurship.

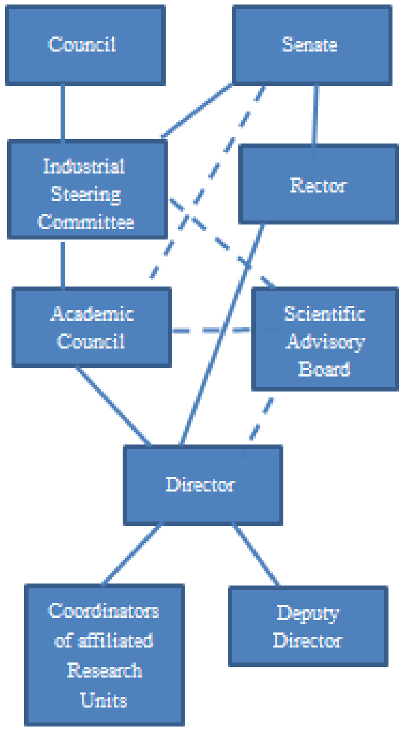

Fig. 2: Governance Structure of CUT Research Institute

(5) The development of shared infrastructure for research in collaboration with industry and the creation of new jobs for young researchers and scientists.

The governance of the Research Institute includes a Director and a Deputy Director, an Academic Council, an Industrial Steering Committee and a Scientific Advisory Board (see Fig. 2). The Institute would be staffed by academic and research staff. Staff members of the Institute would be allowed to have joint appointments/affiliations with industry, in connection to research, technology transfer or the exploitation of ideas/products. In particular, as already mentioned, academic staff would be remunerated from the University's state grant only for their teaching, while for their research work they would be remunerated from external funds that they would be able to attract on a purely competitive basis.

The Institute would be hosting postdoctoral researchers who would be funded from external sources, giving them access to its research infrastructure. Postdoctoral researchers could also be engaged as contract staff on programs funded by own revenues of the Institute. The Institute could also host academic and/or research staff from other universities, research centers or industrial units with which it would have collaboration agreements, either through joint graduate programs or joint research programs or other joint activities. As already mentioned, the financial support of the Research Institute would primarily come from external sources, so that the Institute could be considered a self-financing entity of the University. The sources of external funding of the Institute are expected to include the following:

- Research grants from external sources (national agencies, EU, private sources)
- Graduate tuition
- Consulting
- Endowed Chairs
- Revenue from the exploitation of ideas/ products
- Fees for use of the research infrastructure of the Institute by external users

The revenue of the Institute shall be utilized for the further development and promotion of research, including the development of major public research infrastructure (mainly in collaboration with industry) to be made available to the entire University community and to external users.

At any time, the priority areas of the Institute would be decided by the Academic Council, based on recommendations of the Scientific Advisory Committee and endorsed by the Industrial Steering Committee. The rolling developmental plan of the Institute would be geared by its strategic priorities, and would include the development of new, or the further enhancing of existing, graduate programs or research groups. Areas such as environmental and public health, biotechnology, energy (including petrochemicals and bioenergy), green technologies, information communication technology, etc., are expected to be included in the initial strategic priorities of the Institute.

Based on the above, the establishment and operation of the specified CUT Research Institute is expected to be instrumental in achieving the broader objectives of the University for integrating research with the productive fabric of the country. Additionally, the Research Institute could form the core, or could act as the catalyst, for a future Science and Technology Park of the University or wider.

5 Conclusions and recommendations

CUT is an urban university, growing within and around the historical centre of the old city of Limassol, making this region the focal point for its activities. The University aims to be an integral component of its local community. The actions overviewed above are already generating a positive impact regarding the growth of the University, its innovative links with industry and other stakeholders and by consequence its impact to regional development.

The paper presents actions set forward by a new, urban, technological university with the aim of engaging innovatively and entrepreneurially with industry, business and other local stakeholders, in order to generate revenue from external sources to push its growth and at the same time to have a significant social impact by contributing towards the growth of its region.

We believe that our case presents interesting findings in a period of severe economic crisis where innovation and entrepreneurship should be put to full test as a viable means to turning a crisis to opportunities for growth.

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Exploring The Effect Of University Incubators On The Network Characteristics Of Spin-Outs

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Abstract

University incubators (UI) are now widely regarded as being important in the successful commercialisation of university spin-out (USO) firms. This is reflected in approximately 58% of UK universities and specialist colleges having an on-campus UI in 2010. Yet, despite the growing emphasis on the potential nurturing effect of UIs, for 42% of UK universities, support for USOs and other forms of commercialisation is provided in the absence of a physical incubation facility.

In this paper we contribute to the growing literature examining the value of UI support in the spin-out process. Specifically, we compare and contrast the network characteristics of USO firms in two different university commercialisation contexts. That is, we compare and contrast two research-intensive universities, one with a UI and the other without. Our primary research question is: are there differences in network characteristics for USOs from universities with a UI compared to USOs where no UI exists? The research therefore contributes to a growing critique of the effectiveness of UIs in commercialising academic research and the recognition of positive direct and indirect externalities from participation in networks.

Through interviews and network mapping (social network analysis) for USO firms from two research intensive universities, we profile and explore the formal and informal network ties of USO firms to other USOs from the same university, to host university schools, and to external private firms, universities and laboratories.

Findings show that USOs in the absence of a UI had fewer informal ties but more formal ties to other USOs and to schools within their host university than USOs operating within a UI. USOs operating within a UI also had more formal business relationships with external private firms and universities. Overall, USO formal business ties to other USOs and university schools were extremely sparse.

Major implications here are that (a) tenancy in a UI stimulates informal on-campus ties, which may be of particular benefit to early-stage academic entrepreneurs in terms of support and advice; (b) UI tenant USOs are more embedded in external markets than non-UI USOs; (c) UIs do not act to stimulate formal business within host universities.

Keywords

Incubators, Networks, Spin-outs, Commercialisation.

1 Introduction

In the UK, government policy to promote a knowledge-based economy (Kitagawa and Robertson, 2012) has supported the promotion of university spin-outs (USOs) as well as the formation by universities of technology-based incubators (Lambert, 2003; Sainsbury, 2007). While spin-out rates have continued to grow in the past decade (HESA, 2012; Fini et al, 2011), there are concerns about both the high failure and low growth rates of USOs, the cost-benefit to universities from supporting these firms (Colombo and Piva, 2012) as well as the regional and national externalities they generate (Salvador, 2011; Harrison and Leitch, 2010; Targeting Innovation, 2008). This presents at least two issues of concern: how can the probability of USO growth be increased, and secondly, from a university perspective, what support can be provided to USOs to overcome their 'liability of newness'?

One institutional approach to support the formation and growth of new ventures has been through business incubators. This is attributed to their perceived role as "intermediary – or mediating – organisation(s), helping newly founded and young ventures to establish cooperative relationships with a broad range of economic actors" (Schwartz and Hornych, 2010: 485). Through these cooperative relationships, start-up firms acquire access to resources and capabilities essential to survival and growth (Aernoudt, 2004; Hansen et al, 2000). By implication therefore, USOs without access to an incubator will not have the same support in forming cooperative links and will therefore have more limited access to resources and capabilities.

Empirical evidence largely points to a net positive effect of incubators on job growth, innovation, and inter-organisational links of new firms (Colombo and Delmastro, 2002). Yet, other research (Tamásy, 2007) suggests that the probability of survival, business growth or innovative activity among incubated and non-incubated firms is not significantly different. For universities seeking to support USOs, these findings create uncertainty as to the anticipated benefits to be derived from establishing an incubator facility as opposed to merely providing entrepreneurial and business support to academics wishing to commercialise intellectual property (IP) created in the university.

While over half (58 percent) of UK universities and specialist colleges in 2011 had an on-campus university incubator (UI) – largely supported through public funding in the late 1990s – 30 percent of UK universities with technology transfer offices had no involvement in any business incubators or science parks, whether on or off campus, and 22 percent of UK universities reporting spin-out activity undertook this in the absence of a UI (HESA, 2012). Given the high capital and operational investment in UIs and efforts to explore alternative ways of supporting USOs (Cooper et al, 2012; Carayannis and Von Zedtwitz, 2005; Durão et al, 2005), it is critically important to understand the additionality that UIs generate for USOs (Bruneel et al, 2012).

In this paper, our focus is on the commercialisation of USOs through the cooperative relationships that they form, and in particular, how these cooperative relationships – networks – differ for USOs with access to a UI and those without. In other words, is there evidence that the structural network of USOs with access to a UI differs to USOs with no access to a UI? We compare and contrast two research-intensive universities, one with a UI (University College Dublin) and one without (Queen's University Belfast). Through interviews with the founders of USOs from the two case universities, and applying social network analysis techniques, we map the formal and informal network ties of USOs to other USOs from the same university, to host university schools as well as to external partners.

The remainder of the paper is structured as follows. In the following section, we summarise the contextual literature around university business incubation and consider the relative strengths and weaknesses of alternative university approaches to supporting USOs i.e. through establishing or not establishing incubator facilities. This review is used to devise hypotheses for a network-based comparative study. Our empirical study, including sample, data collection and data analysis methods, is described in Section III. In Section IV, we present our findings and these are discussed in detail and interpreted in Section V. The concluding section summarises the findings, considers their practical implications, identifies the limitations of the study and suggests avenues for further research.

2 Literature review

Much has been written about changing strategic priorities within the university sector as public sector investment in universities and in academic research has declined (Hewitt-Dundas, 2012; Huggins and Johnston, 2010). Slaughter and Leslie (1997: 8) point to a growth in "academic capitalism" as a means of securing external revenue, and there has been an on-going emphasis on commercially-oriented activity, metrics and outcomes (Grimaldi and Grandi, 2005; O'Shea et al, 2005, Owen-Smith, 2003). Universities are focusing more on the private ownership of IP and a more proactive IP development and exploitation strategy (Siegel et al, 2003; Lockett and Wright, 2005).

One element of this "academic capitalism" has been an emphasis on university spin-outs (USOs), defined as "new ventures that are dependent upon licensing or assignment of [an] institution's intellectual property for initiation" (Lockett and Wright, 2005: 1044-1045). Rates of USO activity are reported to have increased markedly since the late 1990s (Fini et al, 2011; Mustar et al, 2008; Clarysse et al, 2005; Markman et al, 2005) and recent data for UK universities suggests that this trend is being sustained, growing by 46 percent, or an average annual increase of 15.3 percent, between 2008 (160 USOs) and 2011 (233 USOs) (HESA, 2012).

The absolute number and growth rate of USO activity may not, however, be an adequate measure of IP commercialisation or technology transfer because such metrics fail to account for the quality of firms created (Caldera and Debande, 2010). Although there is some evidence of favourable USO survival rates (O'Shea and Allen, 2008; Di Gregorio and Shane, 2003), other studies find limited turnover or employment growth (Salvador, 2011; Harrison and Leitch, 2010; Mustar et al, 2008), lower than anticipated financial returns to universities and regions (Colombo and Piva, 2012) and, in some contexts, high failure rates (Targeting Innovation, 2008). In light of this, some observers have raised doubts over the economic potential of USOs and questioned policy makers' investments in promoting spin-out activity (Schwartz and Hornych, 2010; Mustar et al, 2008), with Gilsing et al. (2010: 12) proposing that government prioritisation of spin-out promotion has been based on "policy fashions rather than empirical evidence".

2.1 University incubators

One mechanism proposed to enhance the survival rates, performance and economic contribution of USOs has been university incubators (UIs). An incubator is defined as "a property-based organization focused on accelerating the growth and success of entrepreneurial companies through the provision of business support, resources, and services" (Markman et al, 2008: 1406). UIs are incubators located on university campuses, specialising in the commercialisation of university technology (Allen and McCluskey, 1990) and typically hosting high-tech USOs. Beyond offering tenant firms suitably equipped business premises at attractive rates, they also offer services such as "coaching, mentoring, consulting, general advice, motivation, business introductions, technical appraisal and business network access" (Ahmad and Ingle, 2011:629).

University Incubator (UI) model	**Non-University Incubator (Non-UI) model**
USOs located on-campus in university-administered premises	USOs located in off-campus premises not administered by university *or* on-campus in academic offices/labs
Shared start-up infrastructure and services (phone, heating, reception, meeting rooms, etc.) included	USOs source, install and pay full rate for equipment, internet access, overheads, etc.
USOs can use university address	USOs can use university address
Business support services offered to USOs (e.g. mentoring, advice, business network access)	Business support services offered to USOs (e.g. mentoring, advice, business network access)
USOs have limited time period before 'graduation' (i.e. leaving UI) is required – typically 2-5 years	No formal 'graduation' policy for USOs

Table 1: Characteristics of UI and non-UI USO support models

In contrast to the property-based dimension of UIs (Markman et al, 2008: 1406, Durão et al, 2005) a 'non-incubator' approach to the commercialisation of USOs exists. Here, "universities without a central incubator building supply incubation support to spin-offs located at distributed places on-campus and off-campus" (Van Geenhuizen and Soetanto, 2009: 671). Evidence from the Netherlands and Italy suggests that UIs with "no building space and physical facilities" are common (Colombo and Delmastro, 2002: 1107; see also Van Geenhuizen and Soetanto, 2009), yet this model of university commercialisation support is discussed much less frequently. The validity of the non-incubator approach to supporting USOs is further evidenced by references to 'virtual' incubators (Carayannis and von Zedtwitz, 2005; Durão et al, 2005; Hackett and Dilts, 2004). For example, OuluTech, the commercialisation support unit at the University of Oulu, epitomises this 'non-UI' model, spinning out 10-20 firms per year and being a main contributor to the ‘Oulu phenomenon’ (an exemplar of regional development in Finland), but without a physical incubator (Rasmussen et al, 2006).

2.2 Comparing the UI and non-UI Models

Uncertainty surrounds the sustainability of the traditional benefits provided to new ventures through incubators in an era of globalisation and advances in ICT. Some argue that these forces have eroded the necessity for physical proximity to business partners and that the benefit to firms of clustering (as in UIs) has therefore diminished (Onsager et al, 2007; Durao et al, 2005).

Infrastructural and administrative benefits

Incubators are, however, also found to offer significant benefits to tenant firms, including reduced set-up cost and effort. Typically, USOs and other start-up firms must secure basic infrastructural and administrative resources such as reception services, phone, internet, etc. For incubator tenants, these resources are available, often at below-market rates, so time and money can instead be invested in much needed product or business development (Bruneel et al, 2012). This is of particular benefit to USOs given that lack of resources is one of the most cited obstacles to spin-out success (Van Geenhuizen and Soetanto, 2009). Yet on the other hand, it is argued that USOs may become over-accustomed to the artificially favourable, subsidised business environment of a UI, leaving them blind to the strategies and capabilities of their competitors and unprepared for the highly competitive conditions of ‘real’ external markets (Bøllingtoft, 2012; Inkpen and Tsang, 2005).

Social and knowledge effects

Support from UI management and proximity to other companies may have unintentional and/or intentional benefits for USOs. For example, co-location may result in unintentional informal network ties among tenant firms; this may be particularly important for academic entrepreneurs in terms of avoiding isolation, gaining reassurance and a “sense of common struggle” (McAdam and Marlow, 2007: 363, see also Cooper et al, 2012). Intentional benefits may arise where firms openly partner (formally or informally) with other firms and engage “in deliberate relationships … in order to gather either technical knowledge or market understanding” (ibid.).

Where informal or social ties develop in a UI between USOs (Cooper et al, 2012; Schwartz and Hornych, 2010), the development of relational capital has been found to lead to formal relationships (Bøllingtoft, 2012; Debackere and Veugelers, 2005). This may be particularly important for academic entrepreneurs, where time constraints make formal networking difficult (McAdam and Marlow, 2008). Yet, Lindelöf and Löfsten (2004) argue that informal ties to co-tenants rarely lead to formal transactions or collaborations, instead constituting opportunities which are rarely taken. McAdam and Marlow (2007) attribute this to a 'guarded' atmosphere in the UI, with tenants reluctant to cooperate with one another for fear that knowledge or investment prospects may be stolen. At another extreme, Bøllingtoft (2012: 312) presents evidence that incubator tenants may behave and make decisions in the interests of their co-tenants to their own detriment, "because you have to think of the other entrepreneurs' businesses also". In either case, the evidence suggests that informal links between USOs in a UI are likely to be stronger due to economies of agglomeration and social capital. Further, the evidence that informal links develop into formal relationships between incubator tenant firms suggests that formal relationships will be higher in a UI environment. This leads to our first hypotheses:

Hypothesis 1a: USOs located in a UI will have denser informal network ties to one another than USOs without a UI.

Hypothesis 1b: USOs located in a UI will have denser formal network ties to one another than USOs without a UI.

In addition to the benefits associated with UI support and co-location with other firms at a similar stage of development, USOs in a UI may also benefit from knowledge spillovers from university research. USOs located closer to universities in knowledge-intensive sectors are better positioned to access, commercialise and benefit from future scientific research (Rothaermel and Thursby, 2005; Colombo and Delmastro, 2002), as proximity fosters trust and collaboration between firms and universities (He and Wong, 2012). Therefore, on the basis that proximity to universities increases firms' tendency to access and benefit from university research and knowledge (Rothaermel and Thursby, 2005; Colombo and Delmastro, 2002), this suggests that:

Hypothesis 2a: USOs located in a UI have denser informal network ties to host university schools than USOs without a UI.

Hypothesis 2a: USOs located in a UI have denser formal network ties to host university schools than USOs without a UI.

In the UI environment, there is a danger that the inter-organisational links that USOs form, either informally or formally, will be inward-looking "remain[ing] too much oriented on the academic world", to the neglect of commercial efforts (Gilsing et al, 2010: 16; see also Bekkers et al, 2006). Where links to external organisations outside the UI are lacking, the inter-organisational network of the USO will be characterised by a homogenous group of similar firms that will constrain USOs' development activities. Specifically, such lack of diversity may, for USOs based within UIs, reduce "the chance of unforeseen novel combinations of knowledge which can lead to discovery" (Pittaway et al, 2004: 44).

In addition to the danger of USOs in UIs becoming myopically focused on other firms in the UI, where links do develop, the initial benefit of these may be eroded over time.

For example, Bloodgood et al. (1995) identify three possible problems: expected preferential treatment (where friends become customers but, because of relational capital, expect to be given more favourable terms); poor advice (where friendship distorts the entrepreneurs' perception of whether they are receiving impartial and useful business advice) and; lack of professionalism (where friends become suppliers and take advantage of the relationship by delivering lower quality goods in a less timely fashion than if they were delivering to other customers).

It is worth noting that the effect of location in a UI may also have positive external benefits for USOs. For example, positive credibility effects may arise for UI tenants from their university affiliation (McAdam and McAdam, 2008; Leitch and Harrison, 2005; Rothschild and Darr, 2005; George et al, 2002). Yet, others suggest that the university address in fact hampers firms' ability to be taken seriously in their own right, particularly when seeking venture capital investment (Harrison and Leitch, 2010; Vohora et al, 2004). An explanation is that the university link boosts firm credibility initially but as it matures the relationship becomes a detriment to credibility, signalling that firms "are still in diapers" (McAdam and Marlow, 2007: 368).

With the risk of insularity being one of the most cited risks for USO locating in a UI

	UI - NovaUCD				**Non-UI – QUBIS**		
	Tenant USO	**On-campus USO**	**Spin-In**	**Total**	**USO**	**Shareholding**	**Total**
N	9	6	25	**40**	22	3	**25**
% surveyed	67.0	83.0	64.0	**68.0**	82.0	100.0	**84.0**
Age and size							
Age (years): Mean (median)	7.0 (7.3)	2.5 (2.1)	5.2 (5.2)	**5.1 (4.7)**	10.5 (9.2)	15.8 (14.3)	**11.3 (9.9)**
USO size (no. FTEs): Mean (median)	8.7 (4.0)	4.4 (0.0)	4.9 (2.5)	**5.7 (2.0)**	46.1 (2.3)	9.7 (6.0)	**40.9 (3.0)**
Sector (% of USOs)							
Human health & social work	16.7	0.0	0.0	**4.2**	5.6	0.0	**4.8**
Information and communication	33.3	0.0	56.3	**41.7**	27.8	33.3	**28.6**
Manufacturing	33.3	60.0	18.8	**29.2**	38.9	33.3	**38.1**
Professional, scientific and technical activities	16.7	40.0	25.0	**25.0**	27.8	33.3	**28.6**
Note: Data relates to February 2013 when survey work was undertaken							

Table 2: UI and Non-UI client USO information

(Gilsing et al, 2010; McAdam and Marlow, 2008; Bekkers et al, 2006), it would be expected that:

> *Hypothesis 3: USOs without a UI will have more external network ties than USOs located in a UI.*

A final aspect of our analysis was the calculation and statistical comparison of degree centralisation and fragmentation of UI and non-UI networks. While differences were anticipated to emerge from this analysis, it was a largely exploratory exercise; hypotheses were therefore not formulated.

3 Data and methods

Our empirical study was based on a comparative case analysis of two universities: one with an on-campus UI (University College Dublin) and the other providing business support for USOs but without a UI (Queen's University Belfast). Exploring such a limited number of cases in detail is warranted by the absence of extant research comparing these two models (Dul and Hak, 2007) and by the complexity of collecting, mapping, analysing and comparing network data.

In University College Dublin (UCD), a wholly-owned incubator (NovaUCD) located on the University campus was opened in 2003. NovaUCD's premises comprise business units, desk space and bio-incubation units, as well as a reception service, equipped meeting rooms and a café. Generally, NovaUCD does not invest in tenants but does take an equity holding of fifteen percent in USOs in exchange for UCD IP being assigned to the firm. At the start of 2013, NovaUCD had 34 tenants (Table 2).

Queen's University Belfast (QUB) has a longer history than UCD of formal support for the commercialisation of university research. QUBIS was established in 1984 as a limited company owned by QUB, with the objective of commercialising university research by supporting spin-out activity. QUBIS invests in each USO and, upon receiving equity in the firm, IP is assigned from the University to the USO. USOs can also access, through QUBIS, professional services, IP advice and venture capital networks but, crucially, not university-owned physical incubation facilities. In all, QUBIS has supported 59 firms – 25 of these are still active and have not been acquired. These include off-campus USOs and a small number of non-USO companies in which QUBIS has taken a shareholding (Table 2).

Clients of QUBIS were typically older than clients of NovaUCD – this was unsurprising given the considerable difference in the units' ages and the absence of 'graduation' (short of acquisition/liquidation) in QUBIS. QUBIS USOs had, on average, considerably more employees than NovaUCD firms, however a broadly similar pattern of USOs by sectoral grouping was found in the two contexts (Table 2).

Our approach involved interviewing a founding member of each of the firms – including USOs located in the NovaUCD incubator, on-campus USOs not located in the NovaUCD incubator, spin-in firms to NovaUCD, USOs from QUB and the three non-USO firms in which QUBIS had taken a shareholding. Of the population of 65 firms, overall 68 percent of NovaUCD client firms and 84 percent of QUBIS client firms were interviewed. Data collection occurred between November 2012 and February 2013, with interviews occurring at the firm's premises or a similarly suitable location and lasting for between 45 and 90 minutes. All interviews were recorded (with the exception of two where interviewees did not consent to recording).

Our research interest in this paper is in the structural networks of USOs and the effect of a UI on these. Social network analysis (SNA) was therefore applied given that the principle goal of SNA is "to examine relational systems in which actors dwell and to determine how the nature of relationship structures impacts behaviors" (Rowley, 1997: 893-894). SNA enabled us to map the 'nodes' (individual actors within the network, e.g. organisations) and 'ties' (relationships between nodes, e.g. social and contractual agreements) for the sample. Attributes of nodes and ties (e.g. direction, strength) were also assigned.

Methodologically, our approach recognises that despite the wealth of research on incubator networks (see Bøllingtoft, 2012; Soetanto and Jack, 2011; Scillitoe and Chakrabarti, 2010; Bøllingtoft and Ulhøi, 2005; Hansen et al, 2000), studies applying SNA in this context are rare – see Cooper et al. (2012) for an exception – and, in particular, efforts to compare networks within and outside UIs are lacking.

In collecting data to address our hypotheses through SNA, both categorical and ordinal data was collected:

(a) *Network ties:* all firms were asked to identify all (i) other USOs; (ii) host university schools; (iii) external private firms; (iv) external universities; (v) external publicly funded research centres/laboratories with which their firm had formal or informal ties . Respondents were given a list of all current and former USOs from their university and a list of all academic departments within their host university. For other partner categories, the template was blank and they were asked to list companies, universities, etc. themselves.

External private partner firms were too numerous to list in some cases. These respondents were asked to provide, via email, complete lists of client, supplier and collaborator firms or, where this was not possible or appropriate, an accurate count of partner firms in each of these categories. Usable data was collected from the vast majority of respondents in this way, with 43 of 48 (89.6 percent) providing full data on external private firm partners.

(b) *Strength of ties:* For each reported formal or informal network partner, respondents were required to indicate how frequently they (or someone else within their firm) interacted with them.

Network analysis was carried out using UCINET. After documenting and gauging the strength of all UI and non-UI firms' formal and informal ties, network data from completed templates was inputted to the software by creating and importing DL language text files. Having imported each reported node and tie to UCINET, as well as the attributes of nodes (firm type, age, host university) and ties (direction, frequency of interaction), the software was then used to calculate a range of network statistics:

Network density measures how connected a group of nodes are to one another or to another group of nodes. For networks where ties have values (i.e. strength) – as in frequency of interaction in our data – density is calculated using:

Degree centralisation measures the extent to which a network is dominated by a small number of highly central actors. The test returns a percentage figure, with 100 percent indicating that the network is a fully centralised star structure, i.e. all nodes are connected to one, and only one, central node.

Network fragmentation measures the extent to which network nodes form a single component – where any node can reach any other through mutual ties – versus being fragmented into smaller, disconnected sub-groups. Fragmentation is also stated as a percentage, with 100 percent indicating that no node can reach any other node, i.e. there are no ties among nodes.

Each network statistic could be run using asymmetric or symmetric data[3]. We elected to use symmetric data given that business ties, and in particular formal business ties, are inherently bi-directional. For unreciprocated informal ties, there was a possibility that the founder of Firm A simply was not the point of contact for the founder of Firm B, leaving them unaware that a tie existed between the firms.

SNA requires access to all network nodes and assumes that every node has the potential to be linked to any other, so it could not be applied to data collected on USO network ties to external partners. This data was instead analysed by building a dataset of each respondent firm's reported counts for each external partner category. Descriptive statistics for UI and non-UI (and for sub-groups within each) were calculated and compared statistically[4].

4 Findings

4.1 UI and non-UI network characterictics

Network density

Density of informal ties within the full networks was higher than for formal ties (Table 3). Differences in the overall density of the informal UI and non-UI networks were not statistically significant at 8.23 percent and 8.99 percent respectively. Some differences were found however for the density of informal ties among sub-groups, with links between USOs being significantly greater in the UI context (41.67 percent) compared to the non-UI context (18.18 percent) . This therefore supports Hypothesis 1a that USOs located in a UI will have denser informal network ties to one another than USOs without a UI.

In relation to the density of formal ties, these were very weak for both the UI and non-UI (Table 3). For the full network (including ties among tenants and between firms and university schools), the density of formal network ties was 2.15 percent for the UI and 7.27 percent for the non-UI. Excluding spin-in companies and USOs located outside the UI, we found that the density of formal ties was even lower at 0.00 per cent (i.e. no formal ties) for the UI and 6.06 per cent for the non-UI.

Compared to the UI case, significantly denser formal ties were found within the non-UI full network and within sub-groups, and particularly in USO-school networks (5.81 percent for UI and 12.50 percent for Non-UI). There was limited evidence that the denser informal network structure evident in the UI context translated into formal relationships, contrary to the notion that, through informal networks, relational capital will be developed and this will then translate into formal network relationships (Bøllingtoft, 2012; Debackere and Veugelers, 2005). In contrast, for the non-UI context, it appeared that informal ties were less common and, where links between USOs or USOs and university schools existed, these were based on more formal contractual arrangements. We therefore reject Hypothesis 1b that USOs located in a UI will have denser formal network ties to one another.

Focusing on ties between USOs and university schools we found that in the UI context, USOs were significantly more likely to have informal ties with their university schools than USOs in the non-UI context (12.37 percent and 8.86 percent respectively) (Table 3). However, in the non-UI context, despite lower informal ties, the density of USO-school formal network ties was significantly greater. This again raises questions about informal ties which subsequently convert into formal ties. In the case of the non-UI, formal ties were often formed in the absence of informal network ties.

These findings lead us to accept Hypothesis 2a that USOs located in a UI will have denser informal network ties to schools in their host university than USOs without a UI. However, we have to reject Hypothesis 2b, finding instead that it is USOs

	Density (%)			Centralisation (%)			Fragmentation (%)		
	UI USO tenants	**Non-UI USOs**	**Sig.**	**UI USO tenants**	**Non-UI USOs**	**Sig.**	**UI USO tenants**	**Non-UI USOs**	**Sig.**
Formal network									
Full network	2.15	7.27	***	5.44	10.15		81.90	61.80	**
USO-USO network	0.00	6.06	**	0.00	6.51		100.00	87.90	**
USO-school network	5.81	12.50	***	5.42	10.00		95.80	62.30	**
Informal network									
Full network	8.23	8.99		11.59	16.68		45.80	56.00	**
USO-USO network	41.67	18.18	***	19.64	10.79		41.70	40.70	
USO-school network	12.37	8.86	**	17.04	16.34		74.50	59.10	**
Note: Significance levels: * p<0.10; **p<0.05; ***p<0.01									

Table 3: UI and Non-UI formal/informal network characteristics

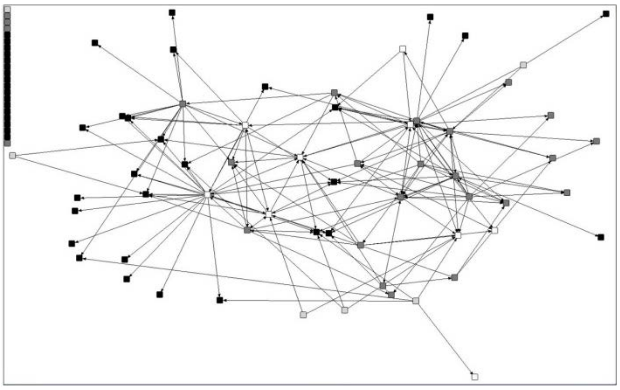

Figure 1: UI informal network map

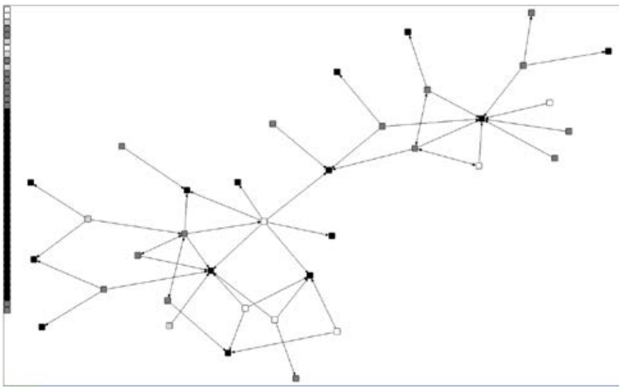

Figure 2: UI formal network map

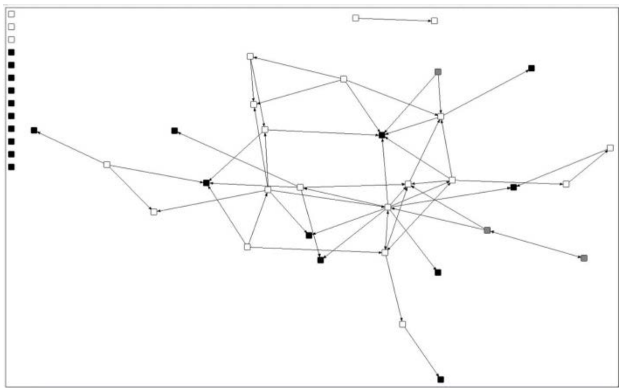

Figure 3: Non-UI informal network map

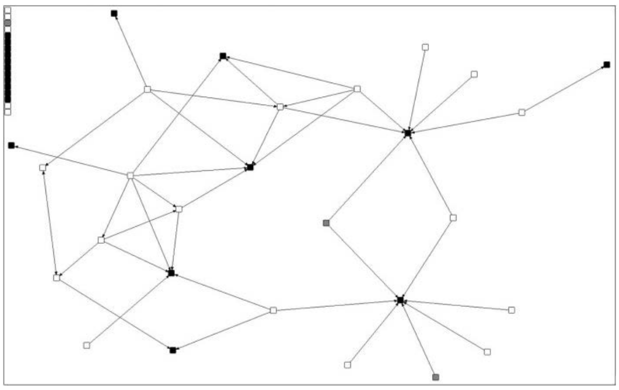

Figure 4: Non-UI formal network map

located in a non-UI context that have denser formal network ties to schools in their host university.

Degree centralisation

Overall, centralisation of the informal networks was only slightly (and insignificantly) higher in the non-UI case than the UI at 16.68 percent and 11.59 percent respectively. However, focusing only on USOs, we found that centralisation was slightly higher in the UI at 19.64 percent, compared to 10.79 percent. Examining this in more detail (Figure 3), within the non-UI, two academic schools are central, with 43 percent of all USOs in the non-UI reporting informal ties to these schools. Within the UI, two tenants were found to be central players, (one USO and one spin-in) with informal ties to 24 separate academic schools, creating a high number of ‘satellite’ departmental nodes and decentralising the overall informal network structure. These structural factors accounted for the decrease (for non-UI) and increase (for UI) in centralisation when school nodes were excluded from analysis.

Not only was the density of formal networks low in both the UI and non-UI, but degree centralisation was also low in both contexts, with no significant difference between the two. Slightly (i.e. insignificantly) higher degree centralisation was found in the non-UI network for the full network, within the USO-USO sub-group, and within the USO-school sub-group (Table 3).

Network fragmentation

Fragmentation analysis results differed greatly for the informal and formal networks. Informal networks were less fragmented than formal networks across both contexts and at all network levels (Table 3). Overall, the full informal network was significantly less fragmented for the UI than for the non-UI, but this finding was not statistically significant for the USO-USO networks in the two contexts. In other words, fragmentation of informal network ties was not significantly different for USOs in a UI or non-UI context. Further, informal USO-school ties were significantly more fragmented in the UI than in the non-UI context. Again this reflects the observation highlighted above in relation to centralisation, with two academic schools being important nodes in the non-UI context while, in the UI, informal ties were spread across 24 different academic schools.

The full formal networks for the UI and non-UI were highly fragmented at 81.90 percent and 61.80 percent respectively. The UI full formal network tended to consist more of discrete component networks, with formal ties between components lacking, whether direct or indirect. This is reflected in the network maps (Figure 2) with the UI having a higher number and proportion of isolates and a clear distinction between two sub-networks connected only by a single tie, and the non-UI resembling more a single component.

The difference between UI and non-UI persisted at the level of USO-USO networks, suggesting a consistent and significant difference in formal network fragmentation (Table 3).

4.2 UI and non-UI external network ties

UI and non-UI counts of interviewees' external partners were tested by group (private firm clients, private firm suppliers, private firm collaborators, universities, publically funded research centres/laboratories) for normality. None of the counts were normally distributed and usable data was returned from 25 UI respondents and eighteen non-UI respondents (i.e. N<30) – the non-parametric Mann-Whitney test was therefore applied in order to compare external partner counts.

	UI USO tenants	**UI all USOs**	**Non-UI USOs**
Customers/clients	25.20	17.60	18.93**
Suppliers	8.40	7.20	5.40
Private collaborators	0.00	0.00	0.73
Total Private	***33.60***	***24.80***	***25.07***
Other universities	3.00	2.00	2.07
Publicly funded research centres/labs	0.40	0.30	1.07
Total Public	*3.40*	*2.30*	*3.13*
All	**37.00**	**27.10**	**28.20**
Note: Significance levels: * p<0.10; ***p*<0.05; ***p<0.01			

Table 4: Mean number of USO external links

USO tenants in the UI reported, on average, more external network ties than USO clients of the non-UI with mean counts of 37.00 and 28.20 respectively (Table 4). This greater number of external partners for UI USOs was consistent across three of the five sub-groups: customers/clients, suppliers and external universities. However, it should be noted that these differences were small and with the exception of the number of links to customers/clients, were not statistically significant.

Based on these findings we reject Hypothesis 3 that USOs without a UI will have more external network ties than USOs located in a UI. Instead, our findings suggest that USOs in a UI may have significantly more customers/clients than non-incubated USOs. This is further supported by the finding (Table 4) that USOs in UCD that were not located in the UI had similar numbers of customers/clients to the QUBIS USOs. Beyond customer/client links, there is limited evidence that being located in a UI has any significant effect on the number or type of external links formed by USOs.

5 Discussion

We found a significantly higher density of informal ties among UI tenant USOs than among USOs in the non-UI context. This is perhaps unsurprising and confirms the findings of other research (Cooper et al, 2012; Schwartz and Hornych, 2010), where co-located USOs forge more and stronger social ties with one another than those dispersed spatially in private premises. In addition, informal ties were denser between USOs and academic schools in the UI context. These findings need to be considered relative to formal network density, which was significantly higher in the non-UI context. This is contrary to other research (Bøllingtoft, 2012; Debackere and Veugelers, 2005), and suggests firstly, that informal ties do not necessarily lead to formal ties (Lindelöf and Löfsten, 2004) and, secondly, that formal USO business relationships can emerge in the absence of informal ties. Rather, the value of the UI might lie in the advice, reassurance and support (informal ties) which early-stage academic entrepreneurs can draw from each another through co-location (Cooper et al, 2012; McAdam and Marlow, 2008).

Network centralisation was not significantly different in the two contexts. However some observations are worth noting. In the UI, centralisation focused around a number of key firms, with one USO founder reporting informal ties to nineteen technology-oriented university schools and revealing that these ties emerged due to the breadth of the business activities and the founder's openness to collaboration and free exchange of knowledge:

> *"Relationships tend to involve us providing expertise free, us providing technical apparatus free or general exchange of advice between experienced people. If we want information, we might be talking to people in School A or School B to get that information but there's no formal agreement, there's no consultancy agreement".*

The other central node in the UI, a spin-in firm, had informal ties with ten academic schools with the aim of developing more formal ties. Again, these links were attributed to a broad-based core technology and to the efforts of UI management:

> *"They cannot do enough for us in terms of integrating us into the college – they are very supportive of all that and they have upped our profile so that we're seen by the schools as being people they can deal with".*

The greater centralisation of UI informal ties were therefore attributable to key firms with certain characteristics (broad business scope and collaborative spirit) which, combined with brokerage activities of the UI, facilitated high connectedness to host university schools.

Formal network centralisation was slightly higher in the non-UI. This was attributable to two university schools with a high number of formal ties to USOs. These key schools in the non-UI were Electronics, Electrical Engineering and Computer Science, and Mechanical and Aerospace Engineering, closely reflecting the 66.7 percent of USOs falling into these sectors.

The UI formal network was more fragmented than within the non-UI context. This finding is in keeping with our formal network density findings, and similar reasons may underlie the differences. Being embedded on the campus, USO incubator tenants could expect that opportunities for on-campus business transactions will automatically be visible to them. They may therefore lack urgency in seeking these out, relative to non-UI client USOs, presenting as fewer formal network ties within and around the UBI (i.e. lower density) and a higher proportion of clients disconnected from one another and from other campus actors (i.e. higher fragmentation).

Differences in informal network fragmentation were inconsistent. The insignificant difference between the UI and non-UI in terms of USO-USO informal network fragmentation is a difficult finding to interpret in light of the very significant difference in density. The informal network diagram of non-UI USO clients showed few isolates and network ties which, while sparse, were sufficient to form one main component comprising 77 per cent of USO clients (Figure 3). Sporadic networking over a long period at events organised by the USO support unit may have produced this structure (whereby USO members are unlikely to know a specific co-client USO directly but are more likely to 'know somebody who knows them'), and kept USO-USO informal network fragmentation to a level comparable to that in the UI.

Significantly greater fragmentation in the USO-faculty informal network within the UI than the non-UI was equally difficult to account for given that density findings again augured the opposite. It could be seen that there were a higher number and proportion of isolated nodes in the informal USO-faculty network of the UI than in the non-UI context (Figures 1 and 3). Almost half of all nodes had no ties to any other nodes and the vast majority of these isolates were schools, explaining why focusing on faculty ties in the analysis increased fragmentation more dramatically for the UI than the non-UI.

The finding that UI tenant USO reported, on average, significantly more network ties to external private customers/clients than non-UI USOs – was contrary to Hypothesis 3.

This suggests that USOs located in a UI are as aware of their external environment as non-UI USOs. This challenges assumptions that UI tenancy breeds insularity and an overly-academic focus and impedes knowledge of external markets (Bøllingtoft, 2012; Gilsing et al, 2010; McAdam and Marlow, 2008; Bekkers et al, 2006; Inkpen and Tsang, 2005).

One possible explanation relates to entrepreneurial commitment levels. For USO founders, the decision to formalise their business by taking on UI premises and committing to a lease could be symptomatic of stronger commitment to the firm. Meanwhile, non-tenancy in a UI could be seen as signalling lower entrepreneurial commitment levels – even in the absence of UI facilities – as typified by the 28 per cent of non-UI respondents whose USOs were headquartered in founders' academic offices. Excluding these

USOs from the Mann-Whitney test eliminated the significant difference between USO clients of non-UI and UI contexts in terms of external customer/client ties. The implication is that the founders of these non-UI USOs are attempting to ‘juggle’ academia and business but this may prevent them from fully committing to their business and aggressively embedding themselves in their target markets, as reflected in their fewer external network ties. On the other hand, UI tenancy in itself represents a demonstrable commitment to the USO on the part of founders; a further sign of such strong commitment may be more urgent and proactive efforts to forge formal business partnerships in external markets, manifesting as a higher number of external ties.

6 Conclusions

One of the key findings from this research is that co-located USOs in a UI formed more and stronger informal ties to one another. It would be expected that the intangible benefits flowing from such informal ties within UIs (e.g. solidarity, reassurance and advice from more experienced co-tenants) are of particular value to academic entrepreneurs given their typical lack of entrepreneurial or commercial experience (Clarysse et al, 2011; Vohora et al, 2004), representing a significant advantage for UIs over the non-UI model.

However, the difference did not translate into business transactions, with formal network ties in fact denser and less fragmented within the non-UI than the UI. These differences were significant but formal ties were extremely sparse in general, and any interpretation must take this into account. We conclude that USO support units, whether physical or virtual, do not seem to stimulate business between actors within the university environment. What is more, the infrastructural investment in a UI reaped no differential return in terms of formal on-campus business and, contrary to some observers (Bøllingtoft, 2012; Debackere and Veugelers, 2005), there was no evidence of informal business ties becoming formal transactional relationships over time.

USO tenants of the UI reported consistently more university-external business ties than non-incubator USO clients, and significantly more in the case of private firm clients. This directly contradicts the idea that UI tenancy fosters academic insularity and impedes USO external network formation (Bøllingtoft, 2012; Gilsing et al, 2010; McAdam and Marlow, 2008); UI tenancy instead seemed to signal a stronger commitment to embedding the USO in its target markets and ultimately moving it beyond its ‘campus company’ status.

The major implication for university policy/decision-makers here is that they should, before committing to UI investment, define and manage their expectations. UI do not necessarily transform campuses into ‘hotbeds’ of commercial activity and this should be understood when considering investment in UI facilities. They do, however, appear to offer some clear advantages over a non-UI model, with these mainly being at the level of tenant USOs, in terms of informal support networks, greater connectedness to external partners in private industry and the opportunity to formalise the firm and the entrepreneur's commitment to it.

A more general finding was that certain schools emerged as central nodes of the UI and non-UI formal networks, perhaps signalling USO specialisation. Identification and cognisance of such schools (i.e. those most commonly partnering with USOs) should be a priority for university policy-makers, so that resources can be allocated and targeted business support provided to schools acting as hubs within the on-campus business network.

The study was subject to a number of limitations. Sample size was an issue and, in particular, more USO respondents on the UI side would have been preferable. However, this simply reflected the apparently low spin-out rate from the host university and, ultimately, over 73 per cent of active USO clients of the non-UI responded.

Due to time and resource constraints, collecting and mapping network data from private firms, universities and public laboratories partnering with USOs was impracticable. Full analysis of university-external networks was therefore not possible and, as a result, our approach to analysing and comparing USO external networks (mean count of reported ties) was quite crude.

The focus of the research was purely at the level of quantitative network analysis. Although this was entirely appropriate given our research question and hypotheses, some qualitative insight would arguably have allowed fuller interpretation of the network data.

A future priority should therefore be qualitative research into the factors underlying USO network formation, in order to increase understanding of why differing network structures and characteristics emerge under UI and non-UI models. Such work could also investigate and compare the benefits which incubated/non-incubated USOs actually derive from their various formal and informal network ties. Full mapping of network ties among the university-external partners of USOs should be a further priority in any future study, so that robust social network analysis can be conducted on the entire UI/non-UI network. Finally, future work might also expand the scope of the current study to focus on networks within and around private incubators, perhaps comparing and contrasting these units to the two university models discussed here in terms of network characteristics, capabilities and benefits.

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[1] Data for the current study showed that 28 percent of all tenant/client USO across both case units (N=73) had ceased trading.

[2] A formal network tie was considered to exist where a contractual agreement had been entered into or money had changed hands between the firm and the partner in question (Bøllingtoft and Ulhøi, 2005). An informal tie was defined as any interaction which involved neither a contract nor a financial transaction.

[3] Asymmetric data takes account of the recorded direction of a tie: where one actor reports a tie to another but this is not reciprocated, only one tie is included in the analysis. Symmetric data assumes that a tie reported in one direction is reciprocated even if the reciprocal tie is not actually reported, so that every connected pair of nodes constitutes a pair of ties.

[4] The Mann-Whitney test involves combining values or scores from two independent samples into a single ordered list, assigning a rank to each score within this list and generating a statistic indicating whether either sample has a significantly greater number of highly ranked scores than would be expected.

[5] This difference was latent in the full network analysis due to the inclusion of university schools as nodes: the higher number of schools (44 compared with 20 for the Non-UI) 'diluted' the UI informal network and gave a misleadingly low density figure.

[6] Isolates are nodes within a network with no inward or outward ties to any other node

The New Chapter Of The Patent Saga Will The Unified Patent Court Make A Difference?

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Abstract

In the light of the new proposal for a Unitary Patent Court, I will argue that it will amplify the existing discrepancies among the system of the European Patent Convention and EU law. Moreover, I will argue that the patent court should have been based on Article 257 TFEU, instead of the employed enhanced cooperation.

Whilst the aims of the EU are encompassing the internal market, human rights, environmental protection etc., the aims of the European Patent Convention are confined to the realm of patent protection. In my view, the inter-relation among the European Patent Office and the European Court of Justice has numerous shortcomings. Regardless of the dissimilarity of objectives, the European Patent Office has shown a great deal of activism and has taken up some of the rhetoric from the European Court of Justice. Such a situation harms the uniformity of EU law and is contrary to the exclusive competence of the ECJ to interpret EU law. The new patent court, as a result of the proposed composition and competences would in my view add to the existing problems. Moreover, the fact that Spain and Italy chose not to be a part of the enhanced cooperation agreement will further the divergences in the interpretation and application of EU law.

Keywords

Unified patent court, enhanced cooperation mechanism, unitary patent.

1 Introduction

The European Commission has spent over 4 decades in an endeavour of creating one single EU patent. The benefits of such an attempt succeeding as oppose to the current system in place are beyond any doubt. The existing system of national patents and European patents, which still must be confirmed in the Member State in which their recognition is sought, is having a highly disincentivising effect on research and innovation in the EU. The overall cost of validation of an average European patent reaches 12 500 EUR if validated only in 13 Member States and over 32 000 EUR if validated in the whole EU, and when compared to the numbers regarding the US, where the cost of a patent does not go above 2000 EUR (European Commission, 2011a), it is more than obvious that a change is necessary. In addition, keeping in force national patents is rendering the EU market for innovation highly fragmented (Van Pottelsberghe De La Potterie and Francois, 2006).

In an attempt to tackle these issues, the Europe 2020 Strategy and the Single Market Act identified the creation of an economy based on knowledge and innovation as a priority, seeking to improve the framework conditions for businesses to innovate by creating unitary patent protection in the Member States together with a unified European patent litigation system. The new system is purportedly considerably cheaper as oppose to the status quo. The European Commission bases this assertion principally on the reduction of translation costs, which are expected to be reduced by as much as 40% (European Commission, 2011b), however, without providing for any tangible data on the costs of setting up the new patent system, as well as those of the new judicial instance.

While not undermining the importance of facts and figures, or the importance of language considerations, this paper also seeks to place an emphasis on the no less important substantive problems of the enhanced cooperation agreement setting in place the unified patent court (UPC). The existing parallel system of national and European patents granted by the European Patent Office (EPO) in the realm of the European Patent Convention (EPC) and its relation to EU law is highly inefficient and is resulting in many discrepancies in application. Regardless of the fact that the EPC is a separate system of international law, the fact remains that all 27 EU Member States are a majority and have significant leverage to perform an influence by way of which EU law must be observed in the system of the EPC. The danger of the spill over effect of such an influence is best depicted through the aims of the two systems - whilst the aims of the EU are encompassing the internal market, human rights, environmental protection etc., the aims of the EPC are confined to the realm of patent protection. The two levels of governance should therefore remain confined to its respective aims, and the dialogue among them should be limited to the aims of a European wide patent protection, and nothing more than that. Conversely, the difference in aims of the two instances seems to be blurred, particularly on behalf of the EPO. In my view, the inter-relation among the EPO and the European Court of Justice has numerous shortcomings. Regardless of the dissimilarity of objectives, the EPO has shown a great deal of activism and has taken up some of the rhetoric from the European Court of Justice. Such a situation harms the uniformity of EU law and is contrary to the exclusive competence of the ECJ to interpret EU law.

The Agreement on a unified patent court (UPC) is one of the by-products of the European patents with unitary effect. As the multi-levelled system of patent enforcement is now to be replaced by a single one, accordingly, the multitude of judicial instances is to be substituted by the UPC as regards the unitary patent, and after 7 years, the European patent. Ostensibly, it is to tackle the issues of uniform application of patent law, the length of procedure and the procedure costs. However, the composition and competences of the UPC would in my view only add to the existing problems. Moreover, the fact that Spain and Italy chose not to be a part of the enhanced cooperation agreement will further the divergences in the interpretation and application of EU law. In essence, the underlying argument of the paper is that the reductions in language and translation costs are nevertheless not a lesser amount of all the accompanying costs resulting from the Agreement on the UPC.

Whereas most of the existing literature is dealing with the analysis of the legality of the use of the enhanced cooperation mechanism for the establishment of the UPC, as well as with the language issues stemming from the development, this paper aims to offer an analysis of the deficiencies of the new judicial instance in substantive terms.

I will firstly critically discuss the existing shortcomings of the relation between EU law and the EPC system, and more specifically, the interrelation between the EU judiciary and the EPO. I will offer an account of the need to change the status quo in the enforcement of patent law in the EU. Secondly, a critique of the Unitary Patent Court as is set up in the enhanced cooperation agreement will be presented, as it will in my view amplify the existing discrepancies among the system of interpretation of the EPC, EU law and national law. Finally, I will argue that the use of the Article 257 TFEU on the possibility of establishing specialised courts would have been a better solution for tackling the present deficiencies of the EPC system, instead of the employed enhanced cooperation mechanism.

2 Shortcomings of the current EPO-ECJ system

The EPC was signed in 1973 and entered into force in 1977, and has ever since been the most advanced piece of legislation to unite, albeit to a limited extent, the patent protection in Europe. It presents a system whereby a patent application is submitted to the EPO, and a bundle of national patents is granted to the patentee. The drawback of such a solution lies in the fact that the patentee nonetheless must register his/her patent in the state in which enforcement is sought. This means that a single patent is going through at least two, however most often through many more procedures of patent registration. This inevitably leads to the application not only of the EPC, but also the application of national law. The signatories of the EPC that are EU Member States are in that sense bound by EU law, as it is the regulatory instance concerning matters after the granting of the patent by the EPO.

There are a number of downsides to the system described above. This will primarily be described through the interrelation between the EPO practice when granting a patent, and the practice of the ECJ in the preliminary reference procedure submitted by courts of Member States. In a theoretical case, the EPO should confine its interpretation to the EPC, and the afterward proceedings that might take place before the national courts1 should take into account the EU legislation in place regulating matters not covered by the EPC. This has unfortunately not been the case and I will take the example of the area of biotechnology, as it in my view most directly depicts the shortcomings of the system of a multitude of judicial instances that have the opportunity to provide for the interpretation of the legislative setting currently in place.

Although all Member States of the EU are contracting parties to the EPC, the European Commission still found it important enough to set in place a directive dealing with biotechnological inventions. The Directive 98/44/EC on the legal protection of biotechnological inventions (the Biotech Directive) is not bringing about many divergences from the EPC, but still, in its Recitals, introduces new aims, those which are not necessarily the aims pursued by the scheme of the EPC. The EPO, when deciding on granting a patent in the area of biotechnology, refers to the Biotech Directive, to its aims, and is taking into consideration questions of fundamental rights and human dignity. Such an interpretation is rather remote from the initial role of granting a bundle of national patents, having one procedure in order to decrease the costs and facilitate the flow of patents in the contracting states. Recital 16 of the Biotech Directive is an excellent example to portray this divergence. It states that patent law must be applied so as to respect the fundamental principles of safeguarding the dignity and the integrity of the person. There is no reason for the EPC to pursue and safeguard such an aim when deciding on the grant of a patent, as it is only seeking to facilitate the applicability of the patent protection throughout the contracting states. It is clearly stated in the Preamble of the EPC that it aims to provide for a patent to be obtained by a single procedure in all the contracting states. However, in the opinion of the Enlarged Board of Appeal of the EPO in the case of WARF/stem cells (EPO, 2008), something quite diverse occurred. Not only has the Biotech Directive been taken into account in the Implementing Regulation of the EPC (EPO, 2004), and defined as a supplementary means of interpretation, the EPO goes as far as to assert that according to the travaux preparatoires of the introduction of Rules 26-29 of the EPC is to “align the EPC to the Directive” (EPO, 2004). It seems as if the Biotech Directive is somehow superior to the EPC and therefore the EPC must be in conformity with it. Furthermore, in the same opinion, the EPO goes on to state that since the essential aim of the Biotech Directive is to protect human dignity, it accordingly interprets the notion of “embryo” in the EPC. What is astonishing is that the EPO almost identifies the legislative intentions behind both pieces of legislation. As a consequence, the patent for the research of stem cells which includes the destruction of human embryos was not granted. Two years after, the Court of Justice in the Brustle case (Court of Justice, 2011a) takes the similar view, stating that the notion of an “embryo” must be given a unique interpretation Union-wide, as the Biotech Directive does not refer to national laws.

Irrespective of whether one finds the human embryo should be a broad or a narrow notion, it is in my view unlikely to conceive that both instances should be called upon its interpretation. Some time ago, in the Relaxin decision (EPO, 2002), the EPO considered itself not to be the proper institution to decide on fundamental ethical questions. The same conclusion should have been drawn for the situation in WARF/stem cells (EPO, 2008), and it is my view that the EPO should have refrained itself from even getting in the discussion on the interpretation of this notion.

In addition to the problems stemming from overstepping the division of jurisdiction among the EPO and the Member States, and consequently the ECJ, there is a further problem as regards the application of patent law. While the EPO is a highly specialised and technical body with a high level of expertise in the field of patents, which renders its activities and interpretation highly insulated, the EU is inherently lacking expertise in the area of intellectual property rights, especially once the matters of interpretation come before the Court of Justice. This substantive and incidental division of competences adds to the problems in communication between the EPO and the ECJ. If we take a look at the composition and the original role of the EPO, it can be noted from the outset that it is not competent for the roles it is assuming, as described above, nor has the legitimacy to conduct them. On the other hand, the lack of expertise on behalf of the European courts is currently inhibiting the broadening of competences on behalf of the European courts. And is one of the reasons more to introduce a new, EU judicial instance that would be specialised for the field of patents, and would address the problems relating to the EPO's interpretation and application of the EPC and its relationship with EU law regulating patents.

There are in my view two main detriments from the above described situation. The first one stems from the political organisation of the European continent. The Member States of the EU comprise the majority of the contracting parties to the EPC. This does not however mean that the legislation enacted on EU level can spill over to non-EU EPC contracting parties. Moreover, the EPO is not entitled to perform the same tasks as the Court of Justice and the Union institutions are. It is on the Court of Justice, despite its lack of expertise in intellectual property, to take into account broader considerations, such as the internal market, human rights, consumer protection and a whole variety of aims that the EU is purporting to achieve. The EPO's role, on the other hand, is simply to provide the contracting parties with a mechanism of granting patents, as well as the interpretation of the technical aspects of the EPC. The concerns that the EU institutions are taking care of are a result of the pluralism of national preferences among the Member States, and whenever something is harmonised at the Union level, there is usually always some space left for the national interests. It is extremely adjusted to EU Member States' individual national preferences, particularly after the new national identity clause inserted in the Lisbon Treaty, Article 4(2) TEU. The EPO is neither equipped (in terms of staff) nor entitled to decide upon such considerations. Here the EPO is the one lacking expertise and legitimacy.

Another problem resulting from the present division of jurisdiction among the EPO and the national courts is the duration of the overall process of patent enforcement. When dealing with cross border cases in which EU law is applicable, all instances of national courts, according to Article 267 TFEU, can refer a preliminary question to the ECJ in order to receive the interpretation of the relevant provisions of EU law. The number of preliminary references is increasing by the year2, and represents a significant 62% of the ECJ's total caseload (Court of Justice, 2011). Furthermore, the duration of the preliminary reference procedure is only slightly decreasing3, and is still considerably burdening the duration of the overall proceedings before the national courts. On the other hand, cases coming directly to the General Court dealing with intellectual property represent 30% of its total caseload, lasting 20.3 months on average in 2011 (Court of Justice, 2011). This set of data clearly points to the unsatisfactory proceedings provided on the jurisdictional setting on the EU level, particularly in terms of duration and costs.

For these reasons I find the relationship among the EPC system and EU law to be greatly deficient and leading to a potentially perilous situation. One can imagine a technical body such as the EPO, taking into account legislative intentions pronounced by the EU, in deciding upon a patent which would be protected both in the EU and outside the EU. This means that now, non-EU contracting parties would virtually automatically assume the goals of the EU and its policy considerations when protecting a patent. On the other hand, as shown above, the EU judiciary as it stands cannot provide for a competitive and economically attractive judicial protection in the area of patent enforcement. Judicial protection must also contribute to the competitiveness of EU businesses and to incentivise research and innovation. In order to address and resolve these problems and tendencies, a new judicial instance for patent cases is certainly more than welcome. An EU specific judicial instance would very well be able to take into account all the aims pursued by the wider and more complex system of EU law. What has been set in place however raises doubts as to its aptness of addressing these problems.

3 Why the UPS is not a solution to the problem

The Agreement on the unified patent court provides for an attempt to resolve the aforementioned problems by way of creating a judicial instance in the realm of both the EPC (reference to Article 142 EPC) and of the enhanced cooperation mechanism from Article 20 TEU. The preamble to the Agreement states that the UPC is to ensure the expeditious and high quality decisions (Recital 6). I consider there to be several problems in the expected benefits to be put forward by the UPC, namely, I find the uniformity of decisions to be handed down by the UPC to be highly questionable, due to its composition and organisation; moreover, the duration of the procedure will be impaired by the possibility of the UPC to make use of the preliminary reference procedure4; finally, the solution to set up the UPC only aims to address the harmonisation of procedural aspects of patent law, whereas the substantive aspects remain divergent, and depend on the national provisions of patent law (as for example the lack of convergence of national rules on compulsory licences), leaving the main incoherencies that hinder the proper functioning of the patent system in the EU, such as market partitioning, in place. This means that the defects from the lack of substantive harmonisation directly translate to problems of performance for the patent court (Jaeger, 2011).

Firstly, the lack of uniformity of UPC's future decisions derives from two main critical points – the fact that it is composed through local and regional divisions, rendering the decision making process highly heterogeneous and dispersed; and secondly from the diverse applicable substantive legal systems which open the possibility of difference in interpretation both in terms of the territorial application of the future judgments and in terms of proliferation of interpretation of legal notions (Hilty et al, 2012).

The first point adding to the inconsistency of the UPC's interpretation and decision making results from the organisational structure as well as the multinational composition of individual panels envisaged in the Agreement on the UPC. The organisational structure purports to establish several local and regional divisions of the Court of First Instance alongside with the central division. As Smits and Bull nicely present (2012), the current system of the Boards of Appeal and the Enlarged Board of Appeal at the EPO and several national courts invest a great deal of effort, such as biannual meetings and institutionally organised communication, in order to ensure the uniform application of patent law throughout the EU. The proposed division in the organisational structure of the UPC does not demonstrate how exactly it represents an improvement as oppose to the status quo. Different interpretations of the same or similar legal notions might appear regardless of the fact that local or regional divisions are formally under one umbrella of the Court of First Instance. What adds to these concerns is the fact that the UPC is not only organised in a way which does not ensure uniformity in interpretation and decision making, but is also detached from the system of national courts, as it becomes the exclusive judicial instance for unitary and European patents. To put it another way, the UPC represents a stop in the communication between various judicial instances and is being insulated without proper guarantees as regards the uniformity of interpretation. On the other hand, national patents remain in the jurisdiction of national courts. This raises the possibility of creating discrepancies between solutions reached by the UPC and national courts. Different solutions and interpretations would be adding to further partitioning of the market in the EU, which is precisely the drawback that is trying to be avoided. In addition to that the situation in which Spain and Italy are not taking part in the enhanced cooperation, the downsides of the system to be set up are more than evident.

As a second point which is in my view challenging the success of the UPC is the possibility it has to refer preliminary questions to the Court of Justice. Certainly this solution is the response to the negative stand that the Court of Justice expressed in its Opinion 1/09 (Court of Justice, 2011b) on the compatibility of the then proposed European and Community Patents Court (ECPC) with the Treaties. The underlying issue at stake is the applicability of Union law to cases to be heard by the then proposed ECPC, as well as the now agreed UPC. On the other hand, the Treaty confers on the Court of Justice the exclusive competence to interpret the Treaties and secondary EU law, and gives the national courts the possibility to refer preliminary questions to the Court of Justice in order to receive an interpretation of Union law when it is a matter of dispute before the national court. The possibility of the national courts to submit a preliminary question is no longer excluded from the Agreement on the UPC. This results in the following burdens concerning the duration of the procedure, its costs, as well as the judicial venues that can decide on the matter: firstly, the duration of the procedure before the UPC is considerably longer than it would have been had there been no obligation of a reference for a preliminary ruling5, additionally the same issue happens at the level of national courts when they decide upon national patents. Given the previously presented statistics on the duration of the preliminary procedure (15.7 months in 2012), and taking into account that the procedure now happens at two judicial instances which, incidentally, no longer communicate as they have separate exclusive jurisdictions as regards patents, we are faced with a situation in which we have two lengthy procedures which do not necessarily need to reach the same solution. A study on the reduction of costs resulting from having a single jurisdiction dealing with patents finds it rather crucial to avoid the multiplication of proceedings before different national courts as the most costly element of the pre-UPC system (Harhoff, 2009). The Regulation on unitary patents as well as the Agreement on the UPC both fail to address this shortcoming, as they provide for a preliminary reference to the Court of Justice, and also, they provide for a jurisdiction of national courts for national patents, which can then, yet again, refer a question to the Court of Justice.

The two interests to be balanced in the present situation – that of compliance with the principles of Union law on the one hand, and that of delivering a timely decision in order to incentivise market participants to innovate on the other, have not been balanced in a coherent manner, rather, each of the elements was taken into account individually. The decrease in the time and costs necessary to obtain a Union patent seems to be a justification enough to change the current system, regardless of the time and costs incurred once the patent is granted. In a nutshell, the costs of translation were reduced in the phase prior to the grant of a patent, whereas the costs of lengthy judicial proceedings were increased.

Since the Agreement on the UPC is based on the enhanced cooperation mechanism, an EU law rather than an international law venue, there have been more options to ensure its compliance and respect for the supremacy of Union law, as oppose to the cumbersome and long-lasting preliminary reference procedure. Alternatively to the specialised court in the realm of Article 257 TFEU, as will be proposed by the present author, the example of the Benelux Court also serves as a good example. It is only responsible for the preliminary reference procedure, after which the procedure is referred back to the national court. Conversely, the national courts and the procedure taking place at the national level should very well provide for a guarantee for the observance and respect of the exclusive jurisdiction the Court of Justice has in interpreting the Treaties, as regards the need to have access to the preliminary reference procedure. Furthermore, the enforcement system in the area of trademarks and designs might serve as a good example, leaving the Member States to designate a limited number of national courts with exclusive jurisdiction in the field of trademarks (Smits and Bull, 2012), without loosening the ties with EU law through the preliminary reference procedure. In addition, the parties themselves might choose the national court of their preference for dealing with their case, leaving it to the jurisdictional competition to designate the most attractive national courts. Data show that more than 90% of all patent litigation in the EU takes place in only four Member States – Germany, United Kingdom, the Netherlands and France (European Commission, 2007). Such development for patent enforcement would not have a detrimental effect to the uniformity as national law remains in force for substantive issues of patent law. The observance and compliance with Union law on behalf of the UPC by way of preliminary reference procedure as it is now, is in my view cumbersome for the smooth flow of patents in the single market.

There is another perilous consequence of the possibility of the UPC to request a preliminary ruling reference. The enhanced cooperation Regulation on Union patents will not stand isolated and separated from the rest of EU law; in opposition, it will develop further and together with the entire system of EU law. Regardless of the fact that Italy and Spain are not parties to the enhanced cooperation on the Union patent and the UPC, they are still bound by the case law of the Court of Justice (Court of Justice, 2010). This would mean that Italy and Spain could be bound by findings of the Court regarding the enhanced cooperation Regulation they are not parties to. Such a development would run counter to the entire idea of the enhanced cooperation mechanism and the possibility of Member States to choose not to be a part of such arrangements.

Finally, it is important to note that the harmonisation in the present case has been done mostly through procedural convergences, and the substantive issues of patent law are still to be relied upon through the EPC, national law of Member States and EU law. This in fact means that what has been created is not a new momentum added in the form of a unitary patent, but only a new way of uniform protection of the bundle of national patents already in force (see also Court of Justice, 2013; Hilty et al, 2012). Article 5 of the Unitary Patent Regulation refers to applicable national law for matters such as transfer of right, rights in rem, treatment in execution and insolvency, erga omnes effect of restrictive contractual licensing, date of third-party effects of patent transactions etc. Moreover, the relations and “cross effects” among the different applicable legal systems are still somewhat unclear (Hilty et al, 2012: 5). The EPO system and EU systems regulating patents are therefore “not mutually exclusive” (Jaeger, 2010, p.66). The result of such a situation is the following, while to each unitary patent there is a single national law applicable, still, different national laws will apply to different unitary patents, rendering the single market highly fragmented, and also adding to legal uncertainty and hindrance of smooth functioning of legal transactions concerning patents. This puts the issue of uniformity in question all the more, as the substantive elements of patent law are still divergent to some extent, and the judicial venues available to market participants also remained quite numerous.

4 A proposal an Article 257 TFEU Specialised Patent Court

The idea of establishing a specialised patent court is not a new one. It was first put forward as a proposal back in 1989 (Council, 1989) under the Community Patents Appeal Court (COPAC). It served as a point of supervision to national courts in infringement cases, as well as an appeal instance to EPO's decisions. However, COPAC's involvement in national procedures was limited to a sort of an interim procedure for questions of invalidity and a preliminary reference procedure for other questions. COPAC was also bound to refer questions to the Court of Justice for a preliminary reference when matters of EU law were involved (Jaeger, 2010). This certainly impaired its aptness to deliver a judgment in a timely, market friendly manner.

The next proposal, that for a Community Intellectual Property Court (CIPC) came only in 2000 (Council, 2000). Differently in comparison to the COPAC proposal, the CIPC would have jurisdiction for infringement and revocation proceedings, however, what was taken away from the proposal was the jurisdiction to decide on appeals to EPO decisions (European Commission, 2000). Such a jurisdictional setting certainly lost significantly in its ability to ensure a unified and harmonised patent law practice. Moreover, as Jaeger rightly points out (2010), such a solution might harm the autonomy of the EU legal order, as there is no EU judicial instance to decide after the EPO, which certainly might be found in a situation where it is applying EU law. As already argued previously, such peril in fact took place in the interpretation and the application of the Biotech Directive by the EPO.

The next and last proposal that used the platform of an EU specialised court was the 2004 Community Patent Court proposal (CPC). The proposal did not bring about a change in the jurisdiction of the CPC to hear appeals from the EPO, which rendered the proposal unworkable. Moreover, the then Court of First Instance (CFI) was to hear appeals, however, there was a strong opposition as regards the expertise of the CFI to hear patent cases.

None of the mentioned proposals came to gain a majority in order to come into force. The UPC proposal as it stands now is outside the realm of Article 257 TFEU on the possibility of a specialised court within the EU judiciary platform, possibly since the Commission found that the domain of international law was more suitable to answer all the deficiencies of the previous proposals (Jaeger, 2010). The next proposal was certainly supposed to satisfy not only the requirements to ensure the autonomy of EU law, but also the EPC system and its effective application.

Although the patent court being founded as a specialised EU court did not hitherto gain the majority among the Member States, it is my view that a proposal which would be encompassing the mandatory jurisdiction of a court to hear appeals from the EPO, when concerning EU law, would add to the uniformity of interpretation and application of patent law. However, it is difficult to envisage a proposal of the court that would satisfy the current shortcomings without amending the Unitary Patent Regulation as well, in terms of jurisdiction for any litigation in which use, validity or entitlement of a patent is in question, preventing the multitude of judicial instances deciding on different issues relating to the same patent.

There are three main arguments in favour of returning to the EU platform of a patent court and patent law enforcement in the internal market: firstly, the uniformity of decision making and interpretation; secondly, the creation of a body with high expertise in patent law on the EU level; and finally, the significant reduction in the duration of the proceedings given that there would not be a preliminary reference procedure necessary while the procedure before the specialised EU court is taking place.

Firstly, a specialised court based on an EU law platform would ensure the uniformity of interpretation and decision making within the entire single market. In my view, a judicial instance whose decisions are binding on national courts, and which has the possibility to decide upon the appeals on EPO decisions, would reconcile the different judicial instances now called upon to interpret patent law from various sources of law, namely national law, the EPC, and EU law, as all national courts when applying national law will be bound by the interpretation which is in line with EU law, as provided for by the specialised court. The EPO, when deciding on matters that concern EU law, will in my view take into account the practice of the EU judiciary in order to make sure its decisions would not be overturned; after all it is currently doing more than it should in terms of interpretation and application of the Biotech Directive, as explained previously. Inserting the decision making of the EPO in the EU judiciary scheme would in my view add to the solution of the current problems the two levels of decision making are encountering. Finally, the specialised court would take away a certain amount of cases coming directly to the General Court. As regards national courts, the jurisdiction would be substantially reduced for cross border cases, retaining in their exclusive jurisdiction solely cases relating to national patents.

Secondly, this would create an opportunity to generate a body of high expertise, something the Union judiciary has inherently been lacking so far, and one of the reasons it was considered that the ECJ is not apt to deal with preliminary references dealing with patent law. This would add considerably to the development of patent law at the EU level, as its development was so far taking place in the EPO practice and the national courts of some particular Member States (as already mentioned the UK, Germany, Netherlands and France). The reliance in the expertise of the EU judges deciding on patents is in my view crucial for encouraging the market participants to take their litigation not only to particular national courts, but also to the EU level. Jurisdictional competition not only among different national instances but also among the EU and national judicial instances would certainly be a positive factor in the development of market friendly and innovation friendly judicature.

Lastly, it is my view that leaving out the preliminary reference procedure out of the picture would significantly add to decreasing the duration of the procedure. As presented above, the current preliminary reference procedure takes in average 15.7 months, and no projection of the possible duration of the proceedings before the UPC has been put forward. A procedure which is confined to one procedure (which is presumably not to last longer or shorter than one procedure before the now proposed UPC) would undoubtedly be more preferable. In the already described competition between the jurisdiction of national courts and the specialised patent court, the parties would surely have in mind this advantage. The only addition in the duration would be the possible appeal to the General Court. If we take into account the current proposal for the UPC, which is envisaging the Court of First Instance and the Court of Appeal, there is nothing additional in the specialised court proposal.

An additional remark as regards the specialised court is that it would entail the language setting that is currently used in Luxembourg, meaning that such a proposal would certainly satisfy Italy and Spain as well. In such a situation, it is my view we would have a true single market for patents, where the competition would then take place among the use of the national or the unitary patent, and the national or the Union court resolving the dispute.

In conclusion, a proposal where the national courts have jurisdiction to hear only cases dealing with national patents and where the jurisdiction of the specialised court concerns all the substantive issues relating to the unitary patent would in my view add to the increase in the uniformity of interpretation; moreover, it would create and EU expertise in patent law and stir up the development of EU patent law; finally, an EU judicial instance which would not take part in the preliminary reference procedure, and whose decisions would be decided by the General Court that is already hearing intellectual property cases would significantly reduce the duration of the procedure, while at the same time ensuring compliance with EU law.

5 Conclusion

This paper started off with a question will the Unitary Patent Court make a difference? Will its competences, its structure and its position in the world of a fragmented and expensive patent market change the course of matters? And ultimately, is any change better than the status quo? In other words, is the current solution beyond the following: “The only theory I can suggest to you is that the EU needs a victory and this can be presented as a victory. This is something they have been trying to do for 40 years. They have almost got agreement on something. It is a very desirable objective and it is being presented, outside the UK, as a victory, as something that the EU can do.” (House of Commons, 2012: 19).

It can be expected that the language arrangements decided by the UP Regulation and applicable for the UPC as well will add a certain reduction in the overall cost of patenting in the internal market as oppose to the status quo. However, beyond the language issues, it is my view that substantively there are more downsides to the UPC. As described, the predominant convergence of procedural patent law issues has not resolved the multitude of applicable legal systems to a single patent, if it is desired for it to be protected in more than one Member State. This results in the uncertainty of all the systems that are to be applied, but also on all the judicial venues that might decide a possible dispute. Moreover, the prospect of various jurisdictions to decide upon one patent renders it highly uncertain for the patentee as to the final interpretation of the relevant patent law to be applied. Finally, it lasts a significant amount of time and costs a considerable amount of money. It is my view that these costs override the savings obtained by the language arrangements, however, adding further issues of uniformity of application of patent law and legal certainty.

The proposal set forth by this contribution is a redefinition of the Unitary Patent for a start, inserting more substantive convergence as oppose to the current procedural. Moreover, a patent court in the realm of EU law, namely the specialised court based on Article 257 TFEU would answer the shortcomings of the current UPC Agreement in terms of uniformity of interpretation and decision making, expertise on an EU level and the overall duration of the proceedings. Regardless of the fact that this is surely not the first nor the last proposal for a 257 TFEU specialised court, in my view, it is a solution worth considering as it takes a more single market friendly approach and creates an added value on the EU level, once we did not have so far - a court of patent specialists. Given the importance the EU is placing on innovation as a way out of the crisis and as an answer for raising competitiveness of EU businesses, a more studious and long-term result is more than preferable.

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B. Notes

1. And before the Court of Justice by way of the preliminary reference procedure.

2. A 59% increase in the number of cases from 2007 to 2011.

3. From 19.3 months in 2007 to 15.7 months in 2012 (Court of Justice, 2012).

4. A solution chosen to tackle to negative opinion of the Court of Justice as regards the European and EU Patent Court proposal from 2009, see Opinion of the Court of Justice 1/09.

5. The obligation to abide by the exclusive jurisdiction of the Court of Justice to interpret EU law would not be prejudiced if the patent court was established through Article 257 TFEU, more to be discussed in the following chapter.

Partnering Universities And Companies In Russia: Effects Of Matching Grants

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Abstract
The paper focuses on analysis a new government instrument to foster the development of university-industry links by giving matching grants to companies with obligation to order R&D to university-partner. The objectives of the study included analysis of motivation for cooperation both from side of universities and companies; primary effects and side-effects of matching grants.

The research results are based on in-depth interviews conducted in 2011-2012 with representatives of companies and universities. Total 40 teams were surveyed.

Our findings show that major motivations from side of universities were possibility to get valuable research tasks from companies, selection of most competitive teams of researchers who may work with companies, and strengthening reputation in business environment. Companies were interested in getting government funding in order to solve their technological problems; to strengthen, due cooperation with universities, their research capacity, and to use modern research infrastructure located at universities.

The major identificated effects of the matching grants include: strengthening of university orientation towards solving practical tasks for business; institutionalization of relations between universities and business in the innovation sphere; harmonization of research and educational activity in universities.

Our recommendations:

(1) The matching grants mechanism turned to be more important for the development of applied and engineering skills at the universities. It is important for this instrument to be as close as possible to the actual demand from companies, but at the same time it should inspire business to invest more in R&D.

(2) It is essential to ease access to matching grants so that to stimulate participation of SME and rapidly growing companies. It would be worthwhile to examine the possibility of creation of companies' consortia under matching grants. Such consortia may be established, for example, in innovative clusters.

(3) The matching grants mechanism is extremely valuable for its indirect, accompanying effects. Evaluation of the results of its implementation should be constructed having in mind this factor, allowing in particular measuring qualitative changes in behavioral additionality.

Keywords
Unified patent court, enhanced cooperation mechanism, unitary patent.

1 Theoretical framework for R&D subsidies

In past decades radical changes in conditions for innovative activity have occurred all over the world. Governments substantially transformed their approach to innovations.

With globalization and growing international competition, policy towards innovations has shifted from being neutral to more proactive, in the form of direct state stimulation of the innovation processes.

There is a wide variety of instruments in support of innovations that have been applied in various countries. These include tax exemptions, target credits, state subsidies, etc. Subsidies to companies for R&D occupy a special place in the list of instruments.

At the beginning of 1990s, the neo-classical theory of growth was widened in a number of research papers (see Romer, 1990; Segerstrom et al., 1990; Grossman, Helpman, 1991; Aghion, Howitt, 1992), illustrating the fact that subsidies for R&D stimulate companies to channel more resources for research and development, resulting in a positive effect on economic growth. Later, a number of theoretical models were developed (see Howitt, 1999; Segerstrom, 2000) to evaluate long-term effect of subsidies on R&D for economic growth.

Teubal (1996, 2002) pointed out that the successful penetration and dissemination of R&D in the new industrial countries was based on intensive group training ("learning by others") and multi-discipline training with the positive results of such learning cumulative through time. Exactly neutral and wide support of R&D at its initial stages makes it possible in the future to identify real market slumps on the basis of sector specifics and to switch to a more selective policy to stimulate innovations.

Within the framework of the evolution approach Bach and Mats (2005) believe that learning failures are basic and interpret them as a limit or constrain to the use of the cognitive capacity of agents and groups of agents. In this connection they draw attention to such problems as lack of coordination between agents, poor development of institutions for the joint development and dissemination of knowledge. This also includes poor tuning and de-synchronization of institutional changes with the current technological changes, codification complexity (lack of standards and platforms), barriers to absorption, etc. It is also noted that support for corporate R&D should be treated, on the one hand, as a mechanism mitigating risks and sharing expenditures, while on the other as a method for developing network interaction and the creation of new collective knowledge.

Since the middle of the 1990s, the practice of public subsidies to companies for R&D began to spread out to the new industrial countries and then to the developed countries. During the last two decades, R&D subsidies to companies remain an important instrument of state innovation policy of the EU countries, Israel, and the USA. To a substantial degree this provided a broad basis for empirical studies of effects of R&D subsidies on companies and also for comparing the results of this instrument with other measures to stimulate innovations.

2 Effects of public subsidies for R&D on compnaies: Evidence from abroad

The effectiveness and results of various instruments for support of R&D investments is one of the key questions in government innovation policy, particularly in the situation of growing budget limitations that is under way in many countries.

Data for EU countries show that in comparison with tax exemptions public financing of R&D at business sector results in more long-term effects (Guellec, y Van Pottlesberghe, 2003). The advantage of R&D subsidies is also associated with their potential for companies to "compensate" market uncertainty. This was empirically confirmed by Czarnitzki and Toole (2007) on the basis of data for production firms in Germany. Therefore if tax exemptions promote primarily the expansion of existing innovation projects, subsidies are directed at the launching new and more long-term projects. Berube and Mohnen (2007) pointed out that the firms receiving grants are more often innovators of an international level and are more successful in commercialization as compared with recipients of only tax exemptions.

Public financing for R&D in business sector accompanied by co-financing is often called "matching grants". Matching grants have other advantages in comparison with other financial instruments to support R&D at companies. They are extremely important for startups and for firms that have launched innovation programs (Hall, Maffioli, 2008). These grants lower the start barrier, promote cooperation and simplify access to outside knowledge.

Hall and Maffioli (2008) systematized the results of evaluation of grant programs in Argentina, Brazil, Chile, and Panama and noted that in all these countries there were visible positive effects in raising innovation activity of companies, in particular in boosting corporate expenses on R&D. The participation of firms in these programs also stimulated positive behavioral changes – a much more active approach by the owners of these firms to innovations and broadening of foreign cooperation. However with regards to improvement of outcome indicators, the results were much more modest. The authors pointed out that possibly this were due to the short period of time. Nevertheless, no statistically reliable empirical data were obtained to testify any positive impact on the number of patents or the volume of sales of new products. With regards to improvement of the overall company competitiveness indicators – such as larger market share, higher productivity – they turned to be indefinite. From one hand there was a positive correlation with the company growth, but from the other - no tangible improvement in productivity.

With the widening practice of R&D subsidies to companies, including those based on "inter-country transfer" and accumulating of subsequent experience, there were identified new problems and risks associated with the application of such instruments. A number of researchers – David, Hall, Toole, 2000; Klette, Moen, Griliches, 2000 pointed out that the effectiveness of public support of R&D in a company could stimulate rent seekers behavior among economic agents with the possible substitution of public funds by private resources. In the course of analysis of the Small Business Innovation Research (SBIR) program effectiveness, Wallsten (2000) discovered a similar substitution effect (it was more evident with the growing number of company personnel). Wallsten noted that the low demonstrative impact of subsidies may limit the multiplicative effect of spent resources.

One of the issues discussed was the influence of subsidies on boosting company innovation activities (growing investments in R&D). But that not always leads to improving of company end results, such as volume of sales of new products, its market share, and labour productivity. It was assumed, for instance, that additional company resources could be used to raise wages of researchers without any changes in the end result of their activity (David et al. , 2000). Besides, Catozzella and Vivarelli (2011) have discovered that with state support R&D expenditures of the companies are higher, however the effectiveness of these expenses is lower (with regards to product innovations).

The effects from R&D subsidies to companies are being actively discussed in Latin America, the newly industrialized countries, and the EU countries - Germany, Belgium, Italy, Finland, Austria (see, e.g.: Aerts, Czarnitzki, 2004; Czarnitzki, Hussinger, 2004; Czarnitzki, Licht, 2006; Czarnitzki et al., 2007; Takalo et al.,2008; Wanzenbock et al., 2011; Czarnitzki, Bento, 2011).

The systematic study conducted by Guellec and v Van Pottlesberghe (2003) occupies a special place in research aimed at evaluating the influence of R&D subsidies on companies in EU countries. The study examined the effect of state financing of company R&D expenses in 17 EU countries for the 20-year period. The researchers also discovered a positive influence of subsidies on R&D financing from side of business. It was noted that target programs for financing companies' R&D ensured better perception and the use by these companies of knowledge generated by the universities.

Cerulli and Poti (2010) examined the effects of subsidies on Italian firms and found out their overall positive influence – both at the stage of increasing R&D financing and the end result – in form of growing number of patents. According to their assessments due to subsidies the additional growth of expenditures on R&D was 40% while the number of patents increased by 3.5%. Meanwhile, the authors identified substantial differences between the two groups of firms: the first group demonstrated positive changes while the second one was associated with the substitution of state resources for private finances. The first group was moiré oriented on obtaining patents and increasing its fixed capital. This group included a big number of large firms but at the same time it shared features of the second group in terms of R&D intensity, structure of expenses, and other indicators of corporate finances. The authors concluded that such results may be explained by two factors. First, larger firms are able to rely on the size effect, namely, they have larger potential for specialization, for entry into networks, for absorption of outside knowledge, for acquiring credits. Second, larger firms have more extended planning horizon, their strategy is more oriented at long-term capitalization. Small Italian firms constitute the traditional family property model combined with the fear to lose strategic control; finally, their owners give priority to current earnings.

Priority in research was given not that much to numerical effects of company activities, as to changes in their behavioral pattern with regard to innovations. On the basis of studies of 1,200 Austrian firms conducted in 2003, Falk (2006) undertook an integrated analysis of effects with emphasis on changes in their behavior. It was noted that large firms demonstrate more often positive changes in their behavior. With continued support there is greater probability for such changes due to their cumulative nature. Wanzenbock, Scherngell, Manfred (2011), studied the activities of 155 firms in Austria and received somewhat different results related to the nature of firms that are ready for a change. The conclusion is as follows: young, small, and technologically specialized firms are much more ready to change their behavior than companies with larger resources for R&D. In this, authors' conclusions are close to those made by Hall and Maffioli (2008).

In terms of assessing possible demonstration effects it is important to note that in his studies Falk (2006) identified some positive effects already at the stage when firm applies for subsidy (even if later the application is rejected). For some firms the very participation in the competition serves as additional motivation to pay more attention to relevant issues.

The highly original study conducted by Aschhoff (2009) deserve special mentioning. It was based on data covering German firms during the period from 1994 to 2006 and was assessing the influence of grants on support of research projects at companies (DPF grants - Direct R&D Project Funding grants). It was shown that the effect of subsidies depends on their size – small grants are less effective. The conclusion was also made that companies with a history of state support (grant recipients) are more inclined to increase their private investments in R&D. However there were no tangible signs that firms with regular public support are less efficient. Aschhoff assumed that this may be associated with the planning effect, i.e. firms may take risk while being aware (based on its previous experience) that the support will be provided later on.

Clarysse, Wright, Mustar (2009) studied the factors which determine the essence of behavioral patterns on the basis of a poll survey of 194 companies that had received subsidies within the framework of the IVVT program (Belgium, 2001-2004) and 84 companies of the control group (that conduct innovation activity but did not received subsidies). The result underlined the importance of the learning effects and identified the fact that inter-organizational interaction stimulated behavioral changes. At the same time the authors have discovered that the learning effect becomes less important with the growing number of projects implementedby the company with the support from the federal budget. This somewhat contradicts to the conclusions of other experts who generally positively assessed the influence of repeated support procedures (Falk, 2006; Aschhoff, 2009).

Overall, matching grants are being considered by experts of international development institutions (Goldberg et al.,2011) as one of the best practices in government innovation policy which deserves special attention and dissemination in countries with an underdeveloped innovation system.

Experts and consultants express mostly positive attitude towards R&D subsidies to companies, based on the results of numerous studies. At the same time it is pretty uncertain that this given instrument is “universally positive. On the basis of research papers presented in review on the subject of subsidies and their impact on corporate R&D (Alonso-Borrego et al., 2012) it appears that out of the 76 empirical micro-level studies 48 cases confirmed the hypothesis about attracting additional resources for R&D. But in 15 cases there were effects of substitution of public funds by private investments. In 13 cases there were no clear effects. If one takes in consideration not only micro-level studies but also research based on sectors and branches of industry, then 71 studies confirm positive effect of R&D expenses, 23 studies identify the substitution effect, and 24 studies show no effect at all. Thus one may see a broad range of studies which have failed to identify even such a basic effect of R&D subsidies as growing private R&D expenses.

Most likely, these results are highly dependent on local conditions in each country concerned, on the exact design of a mechanism to subsidize corporate R&D. Problems regarding methodology of assessment of state support effects remain serious. Therefore many aspects related to influence of matching grants require additional deep studies.

3 Mechanism of matching grants in Russia

During the last 5-7 years Russian innovation policy was developing rather rapidly. During the period of 2006 – 2008, with Russia’s growing government resources, the goal was set to move towards innovation path of development. Judging from the actual measures undertaken, there was an attempt to stimulate in industry demand for innovations. At that time a number of important tax exemption acts were adopted for business, major financial development institutions were set up, and active steps taken to “build up” the innovation infrastructure (see, eg.: Zasimova et al., 2008; Dezhina, 2011; Simachev et al., 2012).

During the acute phase of the crisis (2008 – 2009), the task of stimulating innovation lost its priority and the budget allocations plus individual instruments of the innovation policy were partly “retargeted” to compensate losses caused by the crisis (Simachev et al., 2009). However, simultaneously federal level “re-evaluation” of the role of innovations in terms of ensuring competitiveness of Russian economy was undertaken. As a result the goal of modernization has been finally rooted as one of the main declared government priorities.

Starting from the second half of 2009, there was a re-activation of the innovation policy and not only within earlier implemented directions (tax stimulation of innovation, building up of the system of financial development institutions) but also aimed at initiation of basically new measures (the Skolkovo innovation city, technological platforms, “push to innovations” applied to major state-owned companies, and the mechanism of matching grants). A specific feature of the Russian innovation policy during the post-crisis period was the growing attention to cooperation among the major actors of the innovation process, the development of networks and partnerships within the innovation sphere, and stimulation of research activity within universities.

However the overall situation in innovation sphere may be characterized as not very optimistic in terms of pace of R&D activity in business sector and “connectivity” among actors in innovations system (Tables 1 and 2).

Indicator	2006	2007	2008	2009	2010	2011
Intramural expenditures on R&D, in % to GDP	1.07	1.12	1.04	1.25	1.16	1.12
Allocations on civilian R&D from the federal budget, in % to GDP	0.36	0.40	0.39	0.56	0.53	0.58
Government expenditures in the total on R&D, %	61.1	62.6	64.7	66.5	70.3	67.1
Business enterprise expenditures in the total on R&D, %	28.8	29.4	28.7	26.6	25.5	27.7
Share of organizations that conduct technological innovations, in % to the total number of organizations*	9.4	9.4	9.6	9.4	9.3	9.6
Share of expenditures on technological innovations in % to the total volume of goods produced, works conducted, services implemented*	1.4	1.2	1.4	1.9	1.5	1.5

Table 1: Selected Indicators of Innovative Activity in Russia, 2006-2011

**) Resource extracting, manufacturing, electric power, gas and water production and dissemination plants*

Sources: HSE. (2012). Science. Innovations. Information-oriented Society: 2012. Higher School of Economics, Moscow; HSE. (2012). Science and Technology Indicators in the Russian Federation. Higher School of Economics, Moscow; HSE. (2012). Indicators of Innovation in the Russian Federation. Higher School of Economics, Moscow.

Indicator	US	U	Ge	Fra	Jap	Ch	Ru
Level of private sector expenditures on R&D	5.4	4.6	5.7	4.7	5.9	4.1	3.2
Cooperation between universities and companies	5.8	5.6	5.2	4.0	4.9	4.6	3.7
Level of protection of intellectual property rights	5.1	5.3	5.7	5.9	5.2	4.0	3.0
Availability of venture capital	3.8	3.0	2.8	3.2	2.8	3.3	2.3
Development of value chains	5.1	5.5	6.3	5.7	6.3	4.0	2.6

Table 2: Indicators of the Level of Development of Innovation System, on Scale from 1 to 7, according to Knowledge Economy Index, World Bank (data for 2010). Source: http://info.worldbank.org/etools/kam2/KAM_page3.asp

Instrument of matching grants became one of the government measures aimed at bridging the gap between supply and demand for innovations and to boost private investments in innovations. On April 9, 2010, the Government of the Russian Federation adopted decree # 218 "On measures of state support for developing cooperation between Russian institutions of higher education and the organizations that implement integrated projects aimed at creating high technology production". This decree identified the mechanism of competition-based subsidies on R&D with the aim of financing integrated projects conducted by production enterprises and higher education institutes (universities) in order to organize high tech production.

The Russian mechanism of matching grants may be characterized by the following parameters:

(1) A competition based support from the federal budget – subsidy recipients are selected on the basis of an open competition;

(2) The commercial nature of projects - realization of an integrated project aimed at creating a high tech production is supported;

(3) Support of partnerships and stimulating demand of companies on R&D. The project is carried out jointly by the company and university. The recipient of the subsidy is the production enterprise which uses the funds to finance R&D conducted by the university within the framework of the joint project;

(4) A substantial research component in the project. The subsidy is provided for a period of one to three years in the amount of 100 million rubles (approximately 3.3 million USD) annually to finance R&D conducted by the Russian higher education institute;

(5) Co-financing and distribution of risks. The production enterprise should invest into the project amount of money equal to at least 100% of the subsidy. The organization of a new high tech production facility is financed from own company's resources and at least 20% co-financing shall be used for R&D;

(6) Expected duration of the project and its monitoring. The production enterprise shall provide information on high tech products developed under the project during at least 5 years after the closure of the subsidy contract.

By December 1, 2012, a total of 95 companies and 87 higher education institutes participated in projects aimed at creating of high tech production.

The mechanism for providing subsidies under Government decree # 218 is the first instrument in Russia conceptually similar to the "matching grants" mechanism implemented in a number of countries. Although there are many basic similarities with foreign practice, some insignificant specifics of the Russian mechanism with regard to "matching grants" may be identified, such as:

› Only higher education institutes are allowed to be R&D partners for business in order to obtain government subsidies;

› There is no emphasis on support of private companies' projects;

› Absence of provision to support consortia of enterprises;

› No regular (permanent) procedure for the receipt, evaluation, and support of joint projects by business and universities;

› There are a number of barriers for participation of small and rapidly growing companies in the partnerships.

Although "matching grants" usually constitute a mechanism aimed at stimulating business demand for innovation and R&D, in case of Russia it has developed to a considerable extent into an instrument encouraging universities to cooperate with business. In fact, this mechanism is seen by the government as a method of "teaching" and adapting universities to understand the R&D demand from side of business.

4 Methodology and basic hypothess

The research results presented in this paper are based on informal problem-focused interviews with representatives of companies and universities implementing joint projects on the basis of matching grants.

The use of company and university representatives as initial data sources seems very important when the accent is given to evaluation of behavioral changes. First, in such case there is less probability to face to cautious respondent since behavioral additionality is outside of the sphere of officially monitored results. Second, behavioral effects are basically descriptive. So the use of close-ended questions and a formalized questionnaires will not be beneficial. Behavioral additionalities are poorly digitalized and require qualitative evaluations.

The preliminary results of the study are based on the analyses of interviews conducted in 2011-2012 – 40 in-depth interviews covering 30 projects which received federal support in 2010 within the mechanism of matching grants (28 interviews with representatives of 15 institutes and 12 interviews with representatives of 8 companies).

The main directions of the study nts were based on the following questions:

(1) How did the "design" (the normative framework) of matching grants mechanism affect the composition of participants in the project ? Who was the main initiator to apply for subsidy?

(2) What were the main initial motivations of the parties (the universities and companies) to participate in a project based on matching grants mechanism?

(3) How the importance of various problems has changed in the course of project implementation? Which problems are temporary and which are of long-term nature?

(4) What are the main effects (both positive and negative) of participation in projects? What are the lessons learned by the participants and how do they assess the prospects for further cooperation?

(5) What can be done in order to improve the matching grants mechanism and to increase its efficiency?

The following preliminary assumptions were made for further study and clarification:

(1) Universities are primary initiators to apply for subsidy since they are interested in receiving budget financing. Business is mostly interested in the engineering services provided by the universities.

(2) In the course of the project implementation there will be both positive and negative behavioral effects within the companies and the universities involved in the project. The strongest conflict generating factor with substantial behavioral additionalities is the transition of control over the research results from the government to the company-recipient of the subsidy.

(3) The interaction between universities and companies in the course of projects implementation will reveal many aspects due to mutual influence of scientific and educational processes. The subsidies will have a most substantial effect on the universities since they are better prepared to accumulate and disseminate the results.

5 The results of the analysis

Motivations of Companies and Universities

The analysis of responses to direct and indirect questions about the stimulus for participation in the competition for matching grants reveals a broad spectrum of reasons, both from universities and the companies.

From side of universities four major reasons should be mentioned.

First - most of university representatives pointed out that this is the first measure due to which the university could receive substantial resources for realization of a major research project with serious results. Despite the fact that many universities have sufficient financial resources they are nevertheless limited financially in conducting R&D.

The second important aspect was receiving practical tasks from business, identifying necessary directions for the development of research and engineering competences, the selection of the most competitive research groups. The representatives of a number of universities also pointed out that participation in such projects strengthened reputation of the university among potential business clients.

Third – the projects were seen as a measure to establish or restore cooperation with business.

Fourth – considerable number of university representatives see the matching grants mechanism as a method to support for their research activities, so they are viewed as one of the opportunities to acquire federal support for university development.

As far as companies motivations are concerned, they are, according to our assessments, associated with the following factors. Due to the fact that most companies are not ready to invest into R&D, particularly at the pre-competitive stage, they are more interested in dealing with technological and engineering tasks when it comes to identifying the content of the project.

A successfully developing company is mainly motivated by the perspective to acquire new technology which would increase company’s competitiveness, broaden the volume of sales and will allow entering new markets.

Smaller companies are highly motivated by prospects to strengthen their human capital due to cooperation. In addition, for business it is important to use modern technological equipment within the framework of the project. In a number of universities in recent years there were major improvements made in their technological and testing facilities.

According to our observations small companies were highly motivated by the prospects to get additional resources for their innovation activity, while it was not a major factor for big enterprises.

Effects of Matching Grants Mechanism

We do not examine here direct effects which are associated with the project goals (e.g. growing R&D expenses by companies, additional volumes of innovation product, etc.). We believe it is more important to evaluate the external, institutional effects brought by the matching grants mechanism.

The positive effect of matching grants associated with the orientation of universities on R&D demand from business has been cited by many university representatives at various levels of authority. For university presidents this is an important factor from the point of view of market demand for university services. It also means diversification of institutional activity and for the university researchers - an opportunity to be involved in implementation of practical tasks. The real interest displayed by business in a number of projects may be considered as one of the major result of matching grants mechanism.

Here are some quotations derived from interviews with university representatives:

> *"… I see a sincere interest of company when I communicate with businessmen. I feel whether people have genuine interest or not. In one project this interest is pronounced – these people have shining eyes and they want to know what the university can do for them within the framework of the project";*

> *"…. They got more deeply involved in the projects which promise real product. This entails greater responsibility and higher quality … This confirms that working for the sake of making a product requires special responsibility. There should be high standards set for the project implementation."*

Participation in joint projects also allowed universities to identify the most productive researchers. In a number of cases these were companies who selected university researchers for the joint project and thus matching grants mechanism gave an opportunity to support the best university specialists.

Some cases show that matching grants opened the way to institutionalizing partner relations between universities and business. In one of the interviews a university representative pointed out that in the past the partner companies who needed a specific work to be done preferred to sign contracts directly with the researchers. This form of relations inevitably resulted in conflict of interests. The realization of projects stimulated the formation of joint research groups, enriching their potentials.

> *"Does the university structure allow realization of this project? It does, because the partner university constitutes a conglomerate of its research department and the company. Accordingly, there is no shortage of personnel. If the project would involve only university researchers, then the deficit of the personnel would occur since there would be no engineers and designers involved in the project. They are all in the company-recipient of the subsidy".*

An important effect is that matching grants contributed to sustainability of new research groups that were formed for project implementation: "One of the ultimate tasks following the completion of the project is to retain some kind of professional group", "we would like these ties to develop into some kind of laboratory that would be capable to perform interesting research tasks", " since this is a real project we see a personnel mix and the involvement of young specialists", "there came forth the idea of setting up a center of competence".

In the course of their contacts with universities, some of the companies activated their interaction with other higher education institutes as well. In a number of cases the practical tasks of the projects could not be implemented only by the partner universities. This was the prerequisite for expanding the number of project participants and the formation of research consortiums – "An important result was that in the course of the project implementation the company-recipient of the subsidy created a network of partner universities. Since this is a principally new task it turned out that it was necessary to recruit specialists from various institutes all over the country. The partner university did not have all the required specialists".

The realization of a number of projects stimulated harmonization and enrichment of research and educational activity: at first, several projects were initiated by companies which personnel used to graduate from the partner university. Later, the university was able to attract students to research activities within the framework of the project with the ultimate goal of problem-oriented development of their competence and further employment at the partner company.

> *"A positive factor for the university - additional financing which helps to develop R&D, allows setting tasks to graduate and MA degree students. Later, these researchers will be able to get a job at the enterprise".*
>
> *"What do we expect within the next 2-3 years? The launching of a technological line at the plant which will be the source of further activity for university (training of students and promotion of R&D, adaptation of production)".*

Companies also demonstrated interest in the development of lecture courses for students and even in working out new directions for their training. "University science suffers from huge financial limitations. The Government fails to resolve this problem and no one knows what is to be taught and what will be the cost of such education. For this very reason the company-recipient of subsidy thinks over starting a lecture course on logics at the physics faculty of the partner university".

In conclusion it may be pointed out that most of respondents positively assessed the mechanism of matching grants. They stated that this instrument stimulated interaction between universities and companies. Direct contacts with business are much more interesting and productive for future development. This may be considered as one of the most important positive effects. Of no less importance is the fact that the matching grants encouraged universities to deal with industry and drew attention of business to possible partnership with universities both in research and teaching.

6 Conclusions and recommendations

First, we present some findings of our research:

(1) Compared with other countries where the instrument of matching grants has been used over a long period of time, for Russia it is a fundamentally new tool that significantly modifies the practice of state stimulation of innovation. Its feature is that it aims at stimulating demand for research and development in the corporate sector, as well as at supporting links between business and universities in innovation. In addition, the partners (companies and universities) get roles that are new to them.

In general, it can be seen that the business environment is now much more susceptible to the problems of improving competitiveness in comparison with Russian research and education sector, which is more conservative, objectively more dependent on public support, and in this respect much worse reflects the needs of the market and society.

(2) Relatively little time had passed since the beginning of application of matching grants in Russia until the estimation of their effects in our research – not more than 3 years. It would be wrong to say now that the impact of matching grants was extremely positive or vice versa. However, the mechanism of matching grants seems important because it created the prerequisites for behavioral changes in innovation both for companies and (especially) for universities. We believe that the instrument also brought up very important issues for the state, with respect to the content and principles of innovation policy.

(3) When implementing projects the significance of the problems is constantly being re-evaluated. To a large extent this is due to the process of mutual learning. Quite often in the beginning of use of matching grants (2010-2011) problems were mentioned that either were soluble or were natural for a partnership of business and research organizations. Both kinds of problems are being solved (or becoming acceptable). Say, in the course of project implementation there is a gradual decrease in the importance of some issues such as over-reporting to the state, excessive number of indicators, strict monitoring, difficulties of planning, project management complexity. Even the problem of building relationships between project participants seems more constructive.

At the same time, some issues become more important, such as:

› distribution of intellectual property rights, principles of their use;

› building relationships between companies and universities after the cessation of active phase of the state's participation in the project (end of state co-financing while the monitoring of the results continues);

› providing significant demonstration and synergetic effects by implementing partnership projects;

- development of university management system for effective integration of scientific and educational activities, solution of possible conflicts between different interest groups in the universities.

(4) When implementing projects under matching grants companies and universities are mostly in a positive conflict. Some friction between companies and universities in the implementation of the projects is connected, first of all, with different mentalities and values of businessmen and scientists. Such difficulties tend to be overcome and do not lead to termination of projects. Here, of course, there is a process of improving the understanding of the parties.

(5) Based on our analysis, we can give the following examples of positive effects of the mechanism of matching grants:

increased commitment of universities and their teams to solving practical problems in which the business is interested, increased motivation of scientists (especially young ones) for R&D;

- involvement of students and postgraduates in the research process, clarification of sought and missing competences;
- institutionalization of the relationship between universities and business in innovation sphere, expansion of R&D cooperation, formation of consortia;
- activation of selection of best specialists and departments in universities, receiving (or restoring) of the necessary skills and competencies (above all, relating to engineering applications), modernization of educational programs in line with business needs.

We cannot say that all these effects are typical of most of the projects, but their presence is to a large extent due to the process of mutual learning, transfer of skills within the project partnership. Sometimes this learning is connected with moving of competent staff between business and universities during the implementation of projects: for example, the representatives of the firms enter into the teaching process or the representatives of universities transit (part-time) into research divisions of companies.

(6) 6. Most important: the results of the interviews enable us to note the general orientation of universities and business (their sincere interest) to the further continuation and development of cooperation in the sphere of innovation, not necessarily with the same partner, but in the format "company-university."

In general, it can be stated that the majority of interviewees characterized the mechanism of matching grants as a very positive one, noting that thanks to this tool the interaction of universities with companies increased significantly and working directly with the business is much more interesting and productive for universities future development. This can be considered as one of the most important positive effects. The other fact of great importance is that this tool has allowed to "shake up" universities and to make the business focus on new opportunities to partner with universities in the area of innovation.

And some recommendations.

(1) The matching grants mechanism turned to be more important for the development of applied and engineering skills at the universities. It is important for this instrument to be as close as possible to the actual demand from companies, but at the same time it should inspire business to invest more in R&D.

(2) The mechanism of matching grants will be more effective if to ease participation of SME and rapidly growing companies. It would be worthwhile to examine the possibility of creation of companies' consortia under matching grants. Such consortia may be established, for example, in innovative clusters.

(3) So far this instrument is intended for a demonstration effect, in order to ensure stable and positive results it should be applied during a longer period of time. Therefore it is important to stimulate the "transition" of this instrument to the category of permanent measures of government support of innovation activity.

(4) It is essential to examine the possibility of applying the mechanism of matching grants by various state development institutes in order to implement a continuous cycle of search, evaluation, and selection of innovative projects.

(5) Last but not the least, matching grants mechanism is extremely valuable for its indirect, accompanying effects. Evaluation of the results of its implementation should take into account this factor and include measuring behavioral additionality.

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Building Capacity In South-East Europe: The Role Of Seerc In Regional Development

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Abstract

As transition economies are confronted with challenges such as globalisation, expansion, forces of free market, financial austerity, public sector reforms, accountability pressures, and new quality assurance mechanisms they seek new ways to transform into knowledge-based economies, and are in need of knowledge-rich research capacities and scientific outputs. This is even more so in developing countries, especially those situated in the South East European region, where the resources to support knowledge-based economies are scarce. The provision of high quality Higher Education and specialised research and development are of utmost importance in a developing environment, as universities and research centres can have a fundamental role in driving and sustaining effective regional development. Nevertheless, there is a paucity of research and related literature on the impact of universities and research centres on regional development in the South East European region. The present paper attempts to expand the literature in the field by presenting the case study of the South-East European Research Centre (SEERC), located in Thessaloniki, Greece. By drawing on several performance measurement systems, the paper also discusses impact factors for regional development in South East Europe.

Keywords

regional development, higher education, research centres, South East Europe.

1 Introduction

Transition economies are seeking new ways to transform into knowledge-based economies. To achieve this goal, they need knowledge-rich research capacities and scientific outputs able to respond to the requirements of both EU accession and global development (EU2020, 2011). Therefore, the provision of relevant quality higher education and high-class specialised research and development becomes a necessity. Kefalas et al. (2012) have argued that the knowledge that emerges from higher education institutions and research centres is a vital resource that drives regional development through building capacity within the nearby South East European (SEE) region (when this paper refers to the term "region", it refers to a supranational geographic area such as South East Europe and not to the sub-national geographic and administrative regions such as for example the Region of Central Macedonia in Greece).

The full value (or capacity) is brought forward when local or global knowledge producers are effectively embedded into the regional development process. Developing countries are confronting changes such as globalisation, expansion, forces of the market, financial austerity, public sector reforms, accountability pressures, and new quality assurance mechanisms in a harsher context than developed countries.

At the same time, several knowledge intensive sectors in these countries, such as higher education, research and development, and communication, are rapidly growing, and this may have several implications for the process of regional development. In fact, universities and research centres can play a catalytic role in the process of regional development, and therefore can influence knowledge-based economic development (Kefalas et al., 2012; Youtie and Shapira, 2008; Cochrane & Williams 2010; Shattock et al., 2004; Ketikidis et al., 2010b).

South East Europe has scarce resources to enable regional development, and there is a lack of reports of scientific research regarding the capacities of higher education institutions and research centres to utilise their knowledge and scientific outputs for the benefit of the region. The lack of capacity in SEE is driven by a severe regional brain drain. More specifically, there are several studies from the SEE region which verify the issue of regional brain drain towards more developed, western countries (Horvat, 2004; Chompalov, 2000; Tascu et al., 2002).

This paper aims to fill this gap by presenting the case of the South-East European Research Centre (SEERC) established in Thessaloniki, Greece. SEERC has been successful in building capacity in South East Europe by developing and disseminating knowledge and by fighting the regional brain drain, thus contributing to regional development. This case study may serve as a model for other research centres with similar characteristics (for example, located in regions that underperform in terms of knowledge capacity used as a facilitator for regional development). More specifically, the present paper will:

› Address impact factors for determining the role of higher education and research centres for regional development.

› Present the case study of SEERC, and, through that, identify several performance measurement systems (PMSs) for research centres.

› Discuss how PMSs of research centres can be used to support regional development.

The remainder of the paper presents the case of SEERC (section one), discusses the research methodology (section two), provides an overview of the impact of higher education and research centres on regional development (section three), and discusses the performance measurement system for SEERC in relation to regional impact factors (sections four and five). Section six summarizes SEERC’s regional activities and future strategies before conclusions are given in section seven.

2 SEERC: Management & operational model

2.1 About SEERC

The South-East European Research Centre (SEERC) is an overseas research centre of the University of Sheffield, established as a non-profit legal entity in Thessaloniki, Greece. The centre was founded in 2003 by The University of Sheffield International Faculty, CITY College – a faculty which experienced a successful process of internationalisation of Higher Education (Ketikidis et al., 2012). SEERC conducts multidisciplinary research in the fields of Enterprise, Innovation & Development, Information & Communication Technologies, and Society & Human Development. The belief that South East European (SEE) countries form an area of exceptionally high calibre research underpins the initiative for the establishment of SEERC.

SEERC's mission is to support the stable and peaceful development of South East Europe by conducting pure and applied research in and for the region. The region of SEE is characterised by levels of development that widely vary between countries, political and economic instability and a low level of cross-country business networking, largely due to the region's fragmentation. SEERC employs the existing research capacities of the University of Sheffield and its International Faculty CITY College, by facilitating collaborations between their research staff and by developing multi-disciplinary networks of researchers from across South-East Europe. The Centre was established in the region as a means of building capacity in the region for the benefit of the region.

Research at SEERC addresses the broad range of economic, technological, political, social and cultural challenges facing an enlarged and enlarging Europe, and is organised around three broad areas of concern:

(1) Enterprise, Innovation and Development: this research track includes the clusters: Innovation Policy and Support, Strategic People Management, Applied Economics and Finance, Logistics and Supply Chain Management.

(2) Information and Communication Technologies: the second SEERC Research Track includes the clusters: Intelligent Systems, Software Engineering and Service-oriented technologies, Information and Knowledge Management.

(3) Society and Human Development: Psychology, Politics, Sociology and Education: this research track includes the clusters: Culture and Politics, Health and Social Psychology, Cognitive Neuroscience.

Within each of these research tracks, SEERC encourages the formation of various research clusters, each focusing its expertise on a specific set of research objectives. In line with the international vision established for the Centre, each research cluster draws mainly from the researchers of the University of Sheffield and CITY College, the International Faculty of the University of Sheffield (IF) based in Thessaloniki, and actively encourages participation from other universities, research centres and organisations throughout South East Europe. These research clusters explore their specific research questions through lenses that may be disciplinary, multidisciplinary or interdisciplinary.

Each research track is headed by the research track co-leaders (one from the International Faculty and one from the rest of the University of Sheffield faculties). The research track leaders from the International Faculty, together with the SEERC director and the SEERC chairman participate in the International Faculty Research Committee ensuring in this way the coherence of research strategies between SEERC and the IF. Similarly, the research track leaders from Sheffield participate in the University's SEERC Steering Group which ensures coherence with the research priorities at the University. This system has worked quite effectively and has allowed the research tracks to grow in terms of staff engaged, doctoral students, research funding and networking opportunities.

By focussing the work on specific fields through the research tracks and clusters, working teams are formulated by research associates that are able to address European and global developments in their own field and engage in projects and collaborations that pertain to South East Europe and to topical subjects across Europe. In this way, each cluster builds and expands the specific expertise upon which future development is based.

SEERC benefits from a management and oversight structure that ensures close cooperation between itself, the University of Sheffield's other faculties and the International Faculty. This structure includes the Steering Committee that meets annually to set the strategy and academic orientation of SEERC. SEERC has also established an International Advisory Board whose members represent the triple-helix in each of the South East European countries of interest to SEERC: academia, government and the business sector. In this way, SEERC is able to receive insightful input from within the region and orientation regarding the arising needs and ways to address them.

2.2 Collaborative research

Research at SEERC is in general internally considered excellent if it meets the following criteria: positioned in contemporary debate and discussion; original in the development of new ideas, theories or methods; part of an accepted peer-review process; considered of the highest possible quality according to the internationally accepted evaluation model of the specific discipline(s). Similarly, research at SEERC is internally not considered excellent if it: simply reviews existing research without any further additional insights, ideas, theories or products; is not part of a peer-reviewing process; remains un-assessed in terms of quality according to the internationally accepted evaluation model of the specific discipline(s).

SEERC aims to deliver results of relevance and value to the scientific community, policy-makers, and the general public. To that end, SEERC works through its research clusters that initiate activities leading to funded research projects in collaboration with other research institutes, universities, public bodies and governmental agencies, small and medium-sized enterprises, large enterprises, associations of companies, technology transfer and innovation networks, non-governmental organisations, and many more. Since its establishment in 2003 SEERC has received funding for a significant number of research projects by various funding agencies and funding programmes, including EU funded research. SEERC is currently involved in eleven externally funded research projects and has reached a number of milestones over the last few years:

› Successfully made the transition from FP6 to FP7.

› Expanded and diversified its sources of funded research (which include on top of funding from the Framework Programmes, the Competitiveness and Innovation Framework Program – CIP, the EUREKA program, the Life-Long-Learning Program, the South East Europe transnational cooperation program, the MED transnational cooperation program and other minor ones).

› Successfully concluded 29 externally funded projects.

› Been awarded the first EU-funded project in 2010 as a Coordinator (MORMED, a project that developed a multilingual social networking and content management platform funded by the CIP programme) and has kept up this direction by subsequently coordinating the project ICT-KOSEU, a project funded by the ICT programme (FP7) that aims at supporting Kosovo's (under UN UNSC 1244) efforts for inclusion into the European Research Area by strengthening its capacity to participate at FP7 ICT research and by facilitating its ICT researchers' collaboration with researchers in the EU.

› Been awarded its first Marie Curie Initial Training Network (ITN) project: RELATE, which will allow recruiting of two PhD students and one post-doctoral student in software engineering.

The on-going research projects at SEERC are from diverse areas, including: Cloud computing (Broker@Cloud) and applications (Relate-ITN), intergenerational learning (Silver), capacity building through science centred in the SEE region (SEE Science), tobacco control policy implementation (TCP-HOT), innovation policies in University City Regions (INNOPOLIS), Research policies in the Western Balkan countries (WBC-INCO-NET and ICT-KOSEU), and enterprise development in local communities (ELIEMENTAL), and fostering the creation and growth of innovative SMEs and start-up companies in the region of South-East Europe (VIBE).

The future challenges for SEERC, in terms of funded research, lie in the effort to further diversify its funding sources, as well as in preparing for HORIZON 2020 and the new operational rules as well as for the new realities of structural funds in the upcoming programming period (2014 – 2020).

2.3 SEERC's doctoral training programme

SEERC is committed to growing the number of highly trained researchers working in South East Europe. As part of its mission, SEERC offers opportunities for postgraduate students to undertake research based at SEERC in Thessaloniki leading to the award of a PhD degree by the University of Sheffield. Today there are more than 30 students undertaking doctoral study at SEERC, in either full-time or part-time mode.

The programme aims to:

- build greater research capacity across the region;
- provide greater access to South East Europe for students from elsewhere;
- foster collaboration and the sharing of perspectives among researchers throughout the region and beyond;
- provide research skills to PhD candidates seeking to follow research as a career path.

The Doctoral Programme at SEERC provides several unique features which distinguishes it from other programmes offered in SEE:

- Joint Supervision scheme: To each student two supervisors are assigned: one supervisor from the International Faculty and the other supervisor from one of the other faculties of the University of Sheffield. This scheme exposes the students to a diverse set of knowledge and contacts that originates in the expertise and work of the two supervisors based in different regions.
- Research Training: During the first two years of their studies, students complete a series of theoretical, methodological and subject specific courses, while at the same time conducting research in order to complete a thesis by the end of the third year. SEERC in collaboration with CITY College operates special units that equip students with the skills and competences necessary for conducting research and also for entering academic professional life.
- The Annual South East European Doctoral Student Conference: Each year SEERC organises the Annual South East European Doctoral Student Conference giving young researchers the opportunity to present their work in a doctoral forum. The aim of the conference is to initiate an exchange of knowledge between young researchers and to help establish a network of scholars undertaking research in South East Europe.
- Research Student Seminars: SEERC encourages students to present the progress in their research in small scale events attended by fellow students and staff and to benefit from exposure to an audience of diverse composition. During these events they have the chance to utilise important feedback from

the students and staff in the role of discussants as well as to sharpen their communication and presentation skills.

- Open Seminar Series: Alternatively, experts are invited from related sectors to hold seminars on topics at the forefront of European developments and to raise questions suited to the intellectual background of the students. The Open Seminar Series are planned with maximum student involvement so that students simultaneously develop and apply their organisational skills.

These features have made the doctoral programme popular among potential applicants who go through a competitive process of application and interviews in order to take up one of the offered places. The University of Sheffield offers a number of studentships to support applicants in their efforts.

2.4 Dissemination and outreach

One of the core goals of SEERC is to ensure targeted dissemination of its research findings particularly to South East Europe (SEE). Since 2003 around 50 events have been organised in the region to address topics of importance to South East European countries and also to bring together a range of actors from academia, business and the government to discuss scientific developments in sectors of vital interest to the Balkan countries and Europe. These events consist of international, regional and national conferences and workshops, such as:

- The annual International Conference for Entrepreneurship, Innovation and Regional Development (ICEIRD) – which alternates every year among South East European countries.
- The annual Doctoral Student Conference (DSC) which brings together in Thessaloniki, every year, students from SEE and beyond (other European and non-European countries).
- The bi-annual Balkan Conference of Informatics.

Apart from events, SEERC disseminates research findings to all relevant stakeholders, and actively tries to reach policymakers with policy briefing notes and policy recommendations for their country and/or region. For instance, in the ICT-WEB-PROMS project (funded by the FP7 ICT programme) SEERC produced a report with policy recommendations on the potential of researchers from the Western Balkan countries to participate in the FP7 ICT programme. This report has been made available to the respective Ministries in the Western Balkan countries and has been taken up for discussion in individual meetings with policymakers.

2.5 SEERC publications

SEERC undertakes the publishing of proceedings of the international and regional events it organises as well as the publication of research findings from its funded research projects, which are then disseminated to key targets in the region of South East Europe. Currently SEERC has around 30 main publications from such activities. Additionally, SEERC's researchers publish annually a wide number or research articles in conferences and high impact academic journals. From 2003 onwards, SEERC's publication database provides a number of 475 research papers and conference presentations published by staff and doctoral students.

2.6 Research and Technology Transfer Office of CITY College and SEERC

The Research and Technology Transfer Office generates and supports business initiatives or projects resulting from research at the faculty. This is achieved through:

› Initiating a staff development support framework for researchers and a Faculty-wide Community of Practice for research administrators.

› Supporting policy development and planning in relation to the International Faculty research strategy.

› Contributing to, and providing support for, research strategy and policy development, and championing their implementation.

› Providing targeted support for strategic stimulation activities via the organization of critical mass events and supporting strategic bids and initiatives.

› Providing a gateway to research funding intelligence and funding opportunities.

› Providing the key institutional link with research funders including keeping abreast of, and advising on, funder strategies and policies.

› Internal promotion of the commercialization of academic ideas, and the processing of initial commercial opportunity disclosures.

› Costing, negotiation, and authorization of research contracts.

Overall the research office has an explicit role to manage, organize and improve the competitive performance of research. Figure 1 overviews SEERC's activities.

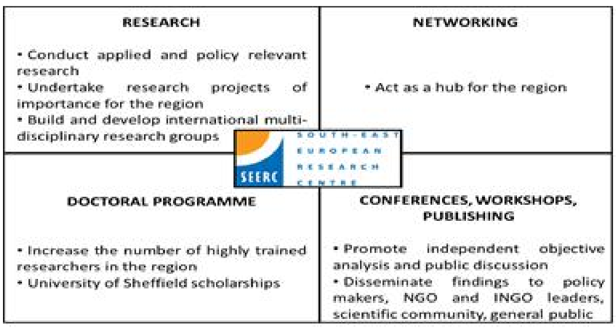

Figure 1: Overview of SEERC's activities

3 Research methodology

The methodology used to develop the case study presented here is based on: (a) a literature review in order to identify regional impact factors of research centres and higher education as well as to identify performance indicators for research centres and (b) utilization of internal resources. For the first aspect, we identified a number of scientific journals and successful case studies published by authors with high citation rates. Additionally, the arguments are strengthened by citing recent policy papers and EU technical reports. Most of the reviewed papers reside within EU countries and focus on the regional aspect (the case studies) as well as the national aspect (the quantitative papers). Concerning the internal resources, we used a number of documents, such as SEERC's profile, its strategic vision and future plans, quality assurance guidelines, internal statistics documents, and more. These were primarily used to pinpoint SEERC's place in the regional development realm. Additionally, key staff involved in the actual regional outputs of SEERC have contributed by sharing their experiences and expertise through in depth interviews and focus meetings.

4 Higher education, research centres and regional development

The relation of Higher Education (including the affiliated research centres) and regional development has gained a lot of focus at a global level; this is because HE institutions can become a catalyst for regional development by creating the conditions for the region to move forward. It is well acknowledged that the regions' powerful academic institutes benefit from high-skilled workforce, from innovative and fresh ideas, from effective knowledge and technology transfer activities and from enhanced academic expertise for business (Etzkowitz, 2003; Woollard et al., 2007). For the purpose of this paper, we are interested in identifying a sufficient number of impact factors of research and academia in order to measure regional engagement. Table 1 presents the results.

Regional Impact factors (RF) of research centres and contemporary higher education on regional development
RF 1. Generation and attraction of talent RF 2. Provision of specialized expertise for R&D besides basic research RF 3. Enable firms to access knowledge from the global research networks RF 4. Tacit knowledge exchange among the networks of innovative firms (Bramwell & Wolfe, 2008) RF 5. Delivery of the "third mission" (O'Shea et al., 2005; Woollard et al., 2007) RF 6. Encompass entrepreneurial attitudes and strategic vision which in most cases leads towards the creation of social capital RF 7. Collaboration with other institutions to assist/support regional innovation (networking) RF 8. Differentiation of approaches towards research and teaching that enable effective technology transfer, firm formation, student education and knowledge advancements. (Etzkowitz et al., 2000; (Etzkowitz, 2003) RF 9. Regional engagement processes are implemented through adjacent technology/science parks, industrial liaison offices. (Gibb et al., 2009; Bloom, 2006) RF 10. Participating in research projects and cooperative educational placements. (Vorley & Nelles, 2008) RF 11. Regional focus on teaching and research. RF 12. Regional focus on student recruitment and retention (Gunasekara, 2006) RF 13. Commercialization of knowledge RF 14. Enable the creation of regional business hubs (Wong et al., 2007) RF 15. Linking local and global actors through knowledge flows. RF 16. Graduates working in the region RF 17. Regional joint research publications (Kefalas et al., 2012;Bergek and Norrman, 2008;Florida et al., 2007; (Youtie and Shapira, 2008; (Mok, 2011; Oliveira, 2008; Kitagawa, 2005; Cochrane & Williams 2010; (Kwiek, 2008; (Shattock et al., 2004)

Table 1: Regional Impact Factors

Table 1 indicates that regional engagement needs to be measured in terms of networks, research and partnerships. The "third mission" of HE Institutions is fulfilled through regional activities. As becomes obvious, regional development needs to be part of any Centre's institutional mission and of its activities; regions with skilled human resources and the potential for innovation lead the way as compared to others locked in more traditional, passive settings. Any institution set to deliver change at a regional level, need to reach out to the community and to draw from its resources. SEERC has a good percentage of its PhD graduates working already in the region and has also engaged in joint publications, making thus a consistent progress towards the regional knowledge transfer process and towards building innovation capacity, which are critical aspects for regional competitiveness (Ketikidis et al., 2010b).

Nevertheless, the factors mentioned in Table 1 are based on an international scale review and comprise the best practices of research centres and higher education institutions from developed countries that have managed to successfully observe the materialization of these factors. However, there is little being said on transitional economies, such as the ones in SEE. Transition economies are in need of a 'knowledge-rich' workforce and at this point, research centres which are tightly linked with universities play a crucial role. Despite this, the SEE region lacks research centres that manage to allow the emergence of the factors from Table 1. There are several reasons for this aspect.

First of all, the majority of universities (and research centres) are public and state funded (Kwiek, 2008), with limited flexibility and market adaptation plus a low level of adoption of quality assurance and excellence frameworks. They have overall a limited regional engagement capacity (knowledge transfer) and they lack willingness to engage with industry and society due to their rigid and outdated management structures. According to Bernasconi (2005), in developing countries, knowledge production targeted to regional development is done especially in private institutions which are market driven and which are able to provide choice or diversity. The reason for this is the limited flexibility and market orientation of the public higher education institutions and research centres. Such traditional universities are too resistant to a bottom-up approach, which means that they are not flexible and agile enough to be able to rapidly change their focus and market orientation, thus impeding the fostering of entrepreneurial practices (Clark 1998). Secondly, universities from SEE can hardly be found in international top university lists, due to their lack of flexibility in their structure and their inability to respond to global trends in Higher Education and innovation. This implies hysteresis in high quality education which leads towards a drain of students to countries with more developed and better quality higher educational systems (Ketikidis et al., 2012). This aspect heavily impacts on the capacity of the remaining workforce in research centres and universities to produce valuable outputs in the given conditions.

To counteract the limitations of the SEE region presented in the previous paragraph, the case of SEERC – a private not-for-profit research centre with a realistic and market oriented strategy that is quality assured by a British university (The University of Sheffield), which is ranked among the Top 100 World Universities - provides the blueprint of a successful model for engaging in regional development in SEE.

5 A regional development oriented performance measurement system

The literature on performance measurement systems is very wide and it provides a variety of PMSs for different research centres. Overall, the main differentiation of the PMSs is done at the stature level of the research centres – whether it is public (Coccia, 2004, Leitner & Warden, 2004) or private (Bremser & Barsky, 2004 and Chiesa et al. 2009). Private research centres may differentiate from public research centres in terms of available funding and in terms of mission definition. Nevertheless, the performance measurement system that we propose for SEERC has a direct link with the regional development drivers. What we aim to measure mostly is the regional development capacity of SEERC by assessing its overall performance. To this extent, Table 2 presents the main indicators for SEERC and their values/description.

Regional Indicator		Value/Description
RI 1.	Number of past collaborative projects	29
RI 2.	Number of current collaborative and/or interdiscipli nary projects	11
RI 3.	The success rate of project acceptance	25%
RI 4.	Number of graduated PhD students	14
RI 5.	Number of current full time PhD students with school arships and overall	13 / 33
RI 6.	Number of current PhD full time students without scholarships	20
RI 7.	Number of current PhD part time students that reside within the SEE region	15
RI 8.	Number of projects with a specific local (Central Macedonia, Northern Greece) engagement.	15
RI 9.	Overall Number of scientific publications of all staff	475
RI 10.	Number of journal publications of all staff	102
RI 11.	Number of conference publication and participation of all staff	180
RI 12.	Number of books/chapters published by SEERC	55
RI 13.	Number of researchers (apart from PhD students)	20
RI 14.	Percentage of researchers that hold a PhD	80%
RI 15.	International environment – how many different na tionalities including PhD students and staff have been present at SEERC.	12
RI 16.	Number of events/conferences organized by SEERC at a local, national, and international level.	30
RI 17.	Number of partnerships with local and international stakeholders	210
RI 18.	Regional engagement activities	The majority of SEERC's activi-ties are regional oriented
RI 19.	Press coverage – dissemination capacities.	Contacts with more than 50 media entities.

Table 2: Regional Indicators for SEERC for 2007-2012 (as a part of a PMS)

Additionally, even though SEERC's target region is the SEE, in order to maintain high research outcomes, the performance measurement system for research and academic output of the University of Sheffield is also being taken as a core reference of setting the research strategic goals and for measuring the results. More specifically, the most relevant indicators for performance measurement of the University of Sheffield for the near future are: Institutional sustainability (income, research grants, education contracts, maintenance and capital expenditure); academic profile and market position (for undergraduates, postgraduates, international students, tuition fees income, regional student entrance to the university aspects); student experience; learning and teaching (percentage of higher 2.1 degrees, lower number of withdrawals, further study or employment capacities of students); research expenditure; increased number of post graduate researchers; research excellence framework performance; number of knowledge transfer licences; financial health; estate infrastructure; staff satisfaction; enhanced roles for women (Sheffield, 2013). However, all these indicators have been specifically adapted and applied for the SEE (cultural) region in order to avoid potential indicator inconsistencies and redundancies due to cultural discrepancies.

6 Summary of SEERC'S regional outreach activities and further strategies

In order to provide the summary of SEERC's regional outreach, the regional indicators from SEERC's performance measurement (Table 2) have been mapped against the regional impact factors from Table 1. To this extent, the following summary can be provided:

› through the collaborative projects (RI1, RI2, RI3), SEERC builds capacity in the SEE region in two ways: first of all, through collaboration with partners from outside the SEE region, SEERC gains best practices and know-how that could be applied within the region; alternatively, if the project partners are from the SEE region, then SEERC contributes to the discussion for regional innovation initiatives (RF7, RF9 RF10).

› through the PhD Programme (RI4, RI5, RI6, RI7), SEERC generates and attracts talent within the region (RF1), assures a regional focus on research and teaching (RF11), promotes a regional focus on student recruitment and retention (RF12), contributes to the region with graduates that predominantly work in the region (RF16) and creates a sound knowledge base of PhD graduates that will disseminate their knowledge in and for the region.

› through the technology and knowledge transfer activities (RI8), SEERC provides specialized expertise for R&D besides the basic research (RF2), enables firms to access knowledge from the global research networks (RF3) and enhances the tacit knowledge exchange among networks of innovative firms (RF4), assisting at the same time the International Faculty towards the delivery of the "third mission of universities" (RF5)

› through the number of publications, conference participations and media coverage (RI9, RI10, RI11, RI12, R18), SEERC provides a great dissemination of its research within the region and internationally (RF13), and at the same time it assures the quality of its research.

› through its qualified researchers and through the internal international environment (RI13, RI14, RI15), SEERC encompasses a wide variety of academic backgrounds which promote entrepreneurial attitudes and strategic vision (RF6) and which also impact on the International Faculty through the differentiation of approaches towards research and teaching that enable effective technology transfer, firm formation, student education and knowledge advancements (RF8), all these being boosters of regional development.

› through the number of events, partnerships and regional activities (RI16, RI17, RI18), SEERC enables the creation of regional business hubs (RF14), and the linkage of global and local actors (RF15).

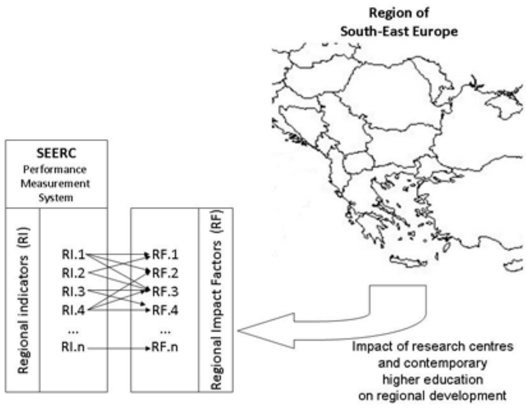

Figure 2: Mapping SEERC's performance indicators against the regional impact factors

Through all these factors (also presented in Figure 2 which shows the correlation between Table 2 and Table 1 and their target effect on the SEE region), SEERC not only fulfils its regional mission (by accomplishing the regional engagement factors of research centres and universities presented in table 1) but it also meets the high standards of the UK Research Excellence Framework (REF, 2012) through the following impact factors defined by this standard: economic, social, public policies and services, health, cultural and quality of life.

Finally, SEERC's strategic objectives for the forthcoming period towards the advancement of the Centre's status to a higher level unfold in three categories: research-wise, administratively and financially. Research-wise SEERC will be looking towards an increase of scientific output and academic impact as well as towards an enhancement of the doctoral programme including the student experience; administratively speaking, an effort will be made to strategically systematise the networking and to cement governance and managerial structures; finally, from a financial point of view SEERC will concentrate on increasing funded research income, on fostering innovation discussion and policy, on maintaining financial sustainability, on investing in human resources to achieve a truly international level recognition and build a strong research-driven brand name.

7 Conclusion

Transition economies are seeking new ways to transform into knowledge-based economies and are in need of knowledge-rich research capacities and scientific outputs. These aspects become even more pressuring for developing countries, which are scarce in knowledge rich resources, especially those from the South East European region where the need for effective knowledge-driven regional development motors is critical. In response to this, we have presented the case of the South-East European Research Centre (SEERC) in Greece, which is a research centre established by CITY College, International Faculty of the University of Sheffield, in Thessaloniki.

SEERC's mission is to support the stable and peaceful development of South East Europe by conducting pure and applied research in and for the region. In this paper we have discussed the roles of higher education and research centres for regional development and we have exemplified the means through which SEERC engages in the regional development of South East Europe. More specifically, we have emphasized SEERC's main features that underpin its regional success: the reputation of a highly reliable project partner; the infusion of knowledge from a top research led university and the ability to network and cooperate with other top research Universities; the PhD programme which includes a multicultural student population; the qualified key staff and scientific output capabilities (publications, knowledge/technology transfer); the networking and academic/industrial event organization excellence; the ability to embed research questions with the needs and aspirations of local and regional stakeholders and the quality of the strategic regional partnerships with academia and industry.

Finally, the learnt lessons from SEERC's experience are:

- Always engage the local stakeholders and derive a research agenda based on their needs and aspirations.
- Research questions need to be constructed in a way that facilitates evidence based policy discussion at the local / regional level.
- Aspire to be a local/ regional "think – tank" that promotes initiatives, tools and policies at the strategic and operational level for local stakeholders.
- Infusion of knowledge external to the region can only be realised if this knowledge is "facilitated/ translated" by local academic staff with knowledge of local needs and specificities.

We believe that the case of SEERC may serve as a model for other research centres from South East Europe that wish to enhance their expertise and engage in regional development.

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Universities' Role In Research, Development, Innovation & Incubation Strategies To Leverage A Nation'S Innovation System: The Tecnológico De Monterrey Case Study

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Abstract

Nowadays, developing innovation capabilities in nation-states is being considered as a strategic issue for economic development of any country. In this sense, Universities are acquiring a more important role to achieve this ultimate objective by developing skills and abilities of human capital in science, technology, innovation and entrepreneurship. Tecnológico de Monterrey University has made an effort towards developing an articulated strategy for research, development, innovation and incubation called: I + D + i2 (acronym in Spanish) to leverage Mexico's National Innovation System. This paper presents the deployment of I + D + i2 strategy and its implications for developing its institutional mission and vision, and enhancing its competencies for technology, innovation and entrepreneurship management. Also, it is provided the full I + D + i2 toolkit, including its strategic planning process, strategic programs, indicators system and management model as a reference guide for other Universities interested in playing the role of knowledge and innovation brokers between industry and academia.

Keywords

Research, Development, Innovation, Incubation, Strategic Planning, Industrial Development.

1 Introduction

The rate of growth of any economy is strongly correlated with its ability to innovate. Since innovation is one of the key strategies for the most developed and competitive countries in the world due to its positive impact on national competitiveness, it is possible to say that the majority of country's or region's capacity for development can be based on innovation (See Table 1).

An innovative country is characterized by its promotion of innovation (drivers), which, in particular, should include: developing the human capital through diverse educational institutions (e.g. Universities) that seek to graduate professionals in science and engineering, and to promote the role of these individuals as active researchers who generate new knowledge for the sustainable development of society; supporting the development of new knowledge, in both the government and the private enterprise, through the creation of new university/ industrial research centers and laboratories, focused on patenting, at international level, to strengthen the national intellectual property as one of the fundamental tools for enhancing a country's competitiveness; and disseminating science and technology through various financial and investment schemes for research projects aimed at developing new technological applications (new value-added products, processes and services) that could leverage the development of countries, such as Mexico; and, finally, applying technology to create high value-added products, and to incubate technology-based enterprises.

Country (Top 10)	**Innovation (2010)**	**Competitiveness (2010)**
Switzerland	2	1
Sweden	3	2
Singapore	10	3
USA	4	4
Germany	13	5
Japan	1	6
Finland	6	7
Holland	8	8
Denmark	9	9
Israel	11	24
Mexico	**69**	**66**

Table 1. Innovation as the Basis for Countries' Competitiveness Country

Under these assumptions, the Tecnológico de Monterrey, has developed a strategy for research, development, innovation and incubation called: "I + D + i^2" (for its acronym in Spanish for investigación, desarrollo, innovación e incubación), considering regional, national and international context that demands an approach based on priority issues by region, while being aligned to global social and technological mega-trends.

This global vision, but also local, will allow I + D + i^2 strategy of Tecnológico de Monterrey to identify the key industrial sectors by region, to determine research areas with the greatest socio-economical impact and to develop specific programs per region towards a competitive development for each region in Mexico. This would be achieved, through the creation of necessary conditions and exploitation of already existing ones in each region by developing internationally competitive value-added industries.

2 The I + D + I^2 strategic planning of Tecnológico De Monterrey

I + D + i2 strategic planning of Tecnológico de Monterrey has three strategic reference points that determine its reference framework and planning process towards the identification of three key components or objectives: (1) identification of development opportunities in high value-added industrial sectors, (2) characterization of priority research areas to support industry, and (3) definition of I + D + i^2 strategic programs for the competitive development of key industrial sectors identified through research and technological development (See Figure 1).

The first strategic reference point of I + D + i^2 strategy is the Mission and Vision 2015 of the Tecnológico de Monterrey, which focuses strongly on research and technological development as a platform to leverage a knowledge-based economy through the management of new innovation, technological development and sustainable development models that are in turn linked to various programs for the incubation, acceleration and attraction of companies with international leadership and social responsibility. The second strategic reference point is the external context, whether international or domestic (national) that influences the I + D + i^2 strategy and which forces continuously shape and guide the strategy's planning and evolution over the time. The third strategic reference point is the internal context that concerns to the mechanisms that will leverage the I + D + i^2 strategy and that will have to be developed and used by Tecnológico de Monterrey to define concrete action plans aimed at strengthening the competitiveness of key industrial sectors and priority research areas fo Mexico through a diverse I + D + i^2 strategic programs.

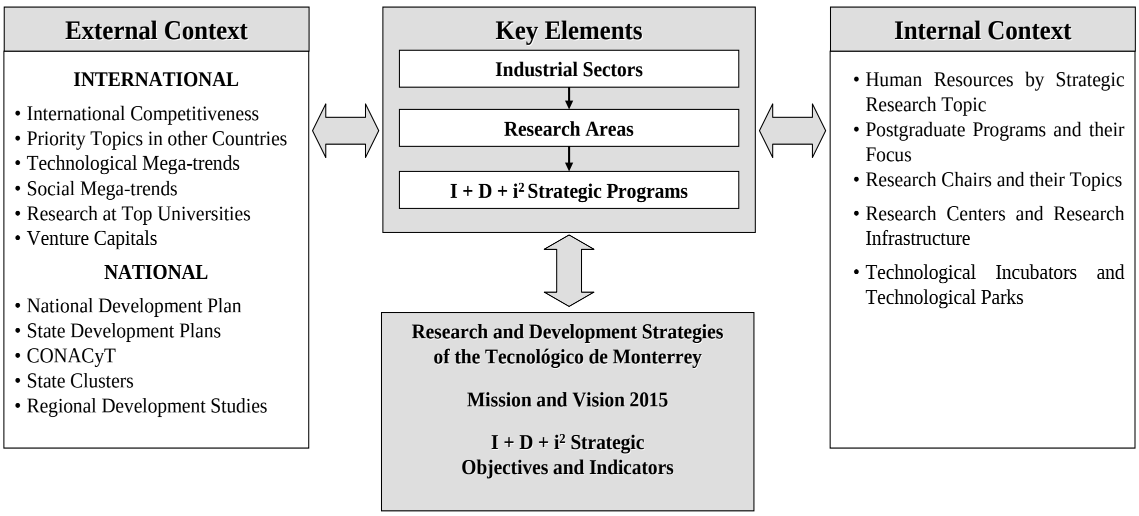

Fig.1: I + D + i2 Strategic Planning

3 External context: International and national

Several strategic referential studies have been conducted in international-external context in order to establish an exogenous reference framework of most important research topics that are currently being developed at international level and to identify industrial sectors and research areas that will have to be strengthened and developed in the country because of their great socio-economical potential for Mexico. Among the strategic reference studies of most importance to I + D + i2 strategy of Tecnológico de Monterrey highlight:

(1) Correlational studies between countries' competitiveness and their rate of innovation through the review of a variety of specialized international reports on this subject. The most valuable of which are the "Global Competitiveness Report" of World Economic Forum, and the "Global Innovation Scoreboard Report" of European Union (See Table 2).

(2) Studies on the priority research topics in leading countries in competitiveness and innovation, placing special emphasis on the Group of Seven (G7), most industrialized countries in the world because of their current political and economic weight on the global scale, as well as on the emerging group of countries known as the BRICS due to their economic potential to become the five most dominant economies by the year of 2050 (See Table 3).

Country (Top 10)	Innovation (2008) [i]	Competitiveness (2008) [ii]	Innovation (2009) [i]	Competitiveness (2009) [ii]	Innovation (2010) [i]	Competitiveness (2010) [ii]
Switzerland	2	2	3	1	2	1
Sweden	6	4	4	4	3	2
Singapore	11	5	10	3	10	3
USA	1	1	1	2	4	4
Germany	4	7	5	7	13	5
Japan	3	9	2	8	1	6
Finland	5	6	6	6	6	7
Holland	9	8	9	10	8	8
Denmark	7	3	7	5	9	9
Israel	13	23	17	27	11	24
Mexico	70	60	67	60	69	66

Table 2: Innovation as the Basis of Countries' Competitiveness (Timeline)

Country	G7							BRICS				
Topic	USA	Japan	Germany	England	France	Italy	Canada	Brazil	Russia	India	China	South Africa
Food						X						X
Biotechnology	X	X	X	X	X			X		X	X	
Pharmaceutics			X	X				X				
Chemical			X		X							
Aerospace	X			X	X					X		
Aeronautic	X				X							
Automotive			X									
Engineering												X
Manufacturing Engineering						X					X	
Maritime Engineering												
Mechanical Engineering												
Medical Devices			X									
Industrial Equipment			X									
Metals and Minerals												
Metal-mechanic												
Nanotechnology	X	X	X		X	X			X		X	
Health	X	X			X	X	X	X				X
Environment	X	X				X	X	X	X		X	X
Forest												
Oceanography	X									X		
Atomic Energy			X							X		
Alternative Energies	X		X		X	X	X		X		X	
Electronic		X								X		
Software	X			X						X		
ICTs	X	X	X	X	X	X	X	X	X		X	X
Human/Society Science					X							X
Security/Terrorism	X								X			
Social Welfare						X						

Table 3: Priority Research Topics at International Level according to National Science and Technology Plans

(3) Studies on technological mega-trends that predict a new technological revolution and show the expected technological advances that will have major economic and social implications in the near future (See Figure 2 and Table 4).

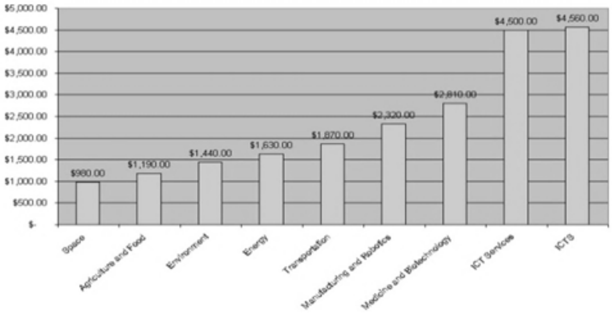

Fig. 2: Technologies' Market Value in Billions of Dollars

1. Cheap Solar Energy	9. Green Manufacturing
2. Rural Wireless Communication	10. Ubiquitous RFID tagging of commercial products and individuals
3. Communication Devices for Ubiquitous Information Access	11. Hybrid vehicles
4. Genetically Modified Crops	12. Pervasive Sensors
5. Rapid Bioassays	13. Tissue Engineering
6. Filters and Catalysts for Water Filtering, Purification and Decontamination	14. Improved diagnostic and surgical methods
7. Targeted Drug Delivery	15. Wearable Computer
8. Cheap Autonomous Housing	16. Quantum cryptography

Table 4. Top Technology Applications for 2020

(4) Studies on social mega-trends that will predict how the world will be in 2015 in its technological, social and economic aspects, identifying examples of businesses, products and services that are in some level of research and/or development, but that in future will represent highly profitable businesses, many of them enabled by emerging technologies (See Figure 3).

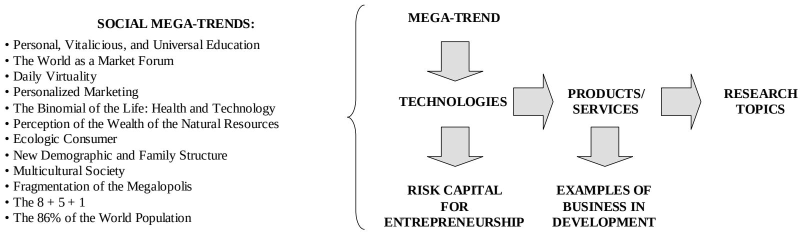

Fig. 3: Social Mega-trends: Reference Information

(5) Studies on the top 100 universities listing their priority research topics (See Table 5) and analyzing the correlation between them and graduate and post-graduate programs, as well as research chairs and their topics.

Topic	Sub-topics
Bio-technology	Bio-imagines
	Pharmaceutics
	Agro-biotechnology
	Biofuels
	Genomics and Proteomics
	Molecular Chemistry
	Bio-materials
Sustainable Development	Recycle
	Macro-ecologic
	Environmental Impact
	Water
	Air
	Energy
	Environmental Conservation
Materials	Advance Alloys
	Complex Fluids
	Semiconductors
	New Materials Development
	Luminescence Materials
	Sensors and Instruments
	Ions Accelerators
	Electronic Dosimetry and Microscopy
Microeconomy (1)	Prices Prediction (O vs. D)
	Systems Design and Risk
	Decisions Theory
	Statistics Equilibrium Models
	Efficient Use of Resources
	Integral Competitiveness Models
	R&D-Business Connection Models
	Economy
Regional and Social Develop-ment	Socio-Technical Systems Design
	Mexico: XXI Century Social Regions
	Studies on Opportunities and Inequality
	Technologies Impact on Society
	Intelligent Social Infrastructures
Enterprise Competitive-ness	Innovation and Creativity Management
	Innovation/Productivity Relation
	Innovation/Growth Relation
	Entrepreneurship
	Supply Chain Management and Logistics
	Competitive Businesses
	Creation of New Enterprises
Medicine and Health Science	Medical Devices
	Software for Medical Applications
	Hospitals Management
	Diseases Treatment y Cure
	Genetics
	Cancer
	Pharmaceutics Design

Nanotechnolog	Nano-sensors
	Nano-structures
	Nano-systems
	Nano-instruments
	Nano-materials
	Nano-crystals
	Nano-filaments
ICTs	Human-Computers Interfaces
	Medical Applications
	Cyber-security
	Multimedia Systems
	Wireless Technology
	e-Business
	Software Design
	Automation
Microeconomy (2)	Taxes
	Hedonic Models
	Studies on Reforms, Pensions y Retire
	Studies on Mobility and Migration
	Macro-dynamics
	Studies on Legislation-Market Relation
	Policy Systems in Development Countries
	Economic Treaties
Knowledge Society	Public Policy Management
	Knowledge Management
	Intellectual Property
	The Market and the Knowledge Society
	The Knowledge Society and the Cultures
Social Sciences	Economic Performance and Development
	Governance and Citizenship
	Life plan, Lifestyle and Health
	Work and Organization
	Environment and Human Behavior
	Knowledge, Communication and Learning
	Social Stability and Exclusion

Table 5: Research Topics in Top 100 Universities

(6) Studies on risk capital for entrepreneurship (venture capital) aimed at identifying the main developments in technology, products and services which are currently funded under this scheme, including their financial structure (See Figure 4).

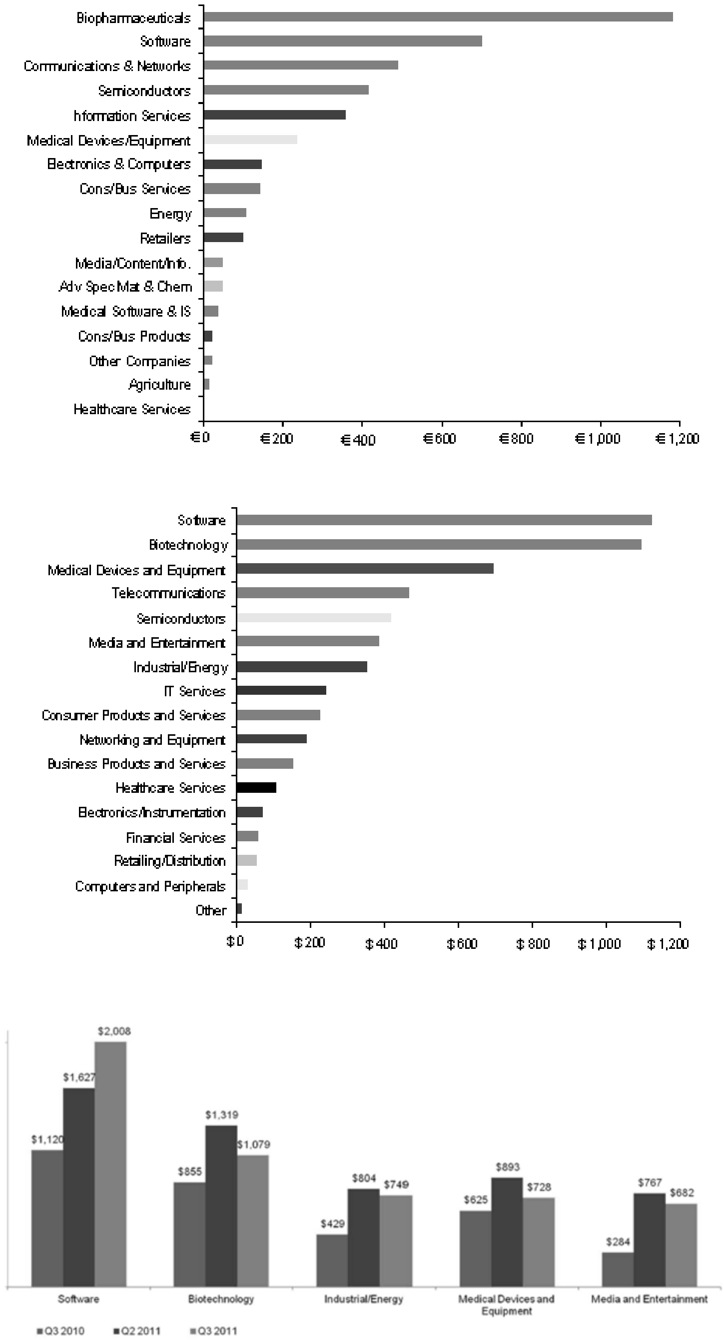

Fig. 4: Developments Funded by Venture Capitals in Millions of Euros/Dollars: Europe - 2006 (Up), United States - 1er. Quarter 2007 (Middle), World - 3rd. Quarter 2011[v-vi-vii]

On the other hand, in the external-national environment several referential studies have been carried out with the strategic aim of analyzing the industrial sectors (clusters) and economic activities that will generate more jobs, income and impacts on the Gross Domestic Product (GDP). Among these studies it is worth mentioning the "coefficient of work" by Michael Porter, used to identify the rate of growth in employment and income by economic activities according to the relevant industries in each region of Mexico, through regional development studies, with the aim of determining the industrial development approach of I + D + i^2 strategy. Additionally, the industries that might be created, attracted, converted and/or upgraded to strengthen the development of different regions of Mexico were identified (See Figure 5 and 6).

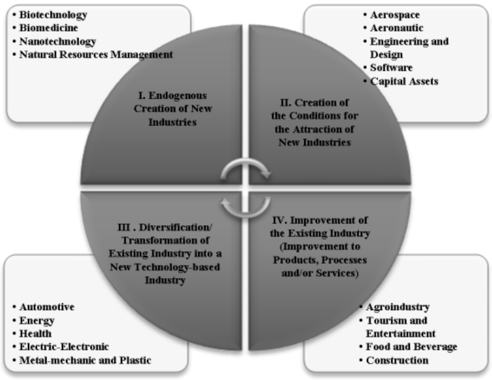

Fig. 5: I + D + i^2 Strategy focused on Industrial Development in Mexico[viii]

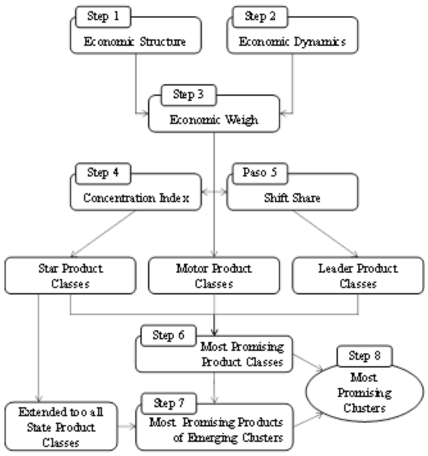

Fig. 6: Methodology for the Identification of Emerging Clusters

In addition to the coefficient of work study, several other studies were conducted to relate the key industries identified versus the technologies and disciplines that support the development of these industries. The impact of these technologies versus the products of each industry was also studied in depth to determine their needs in terms of research and technological development to create new industries, products and/or services (See Figure 7).

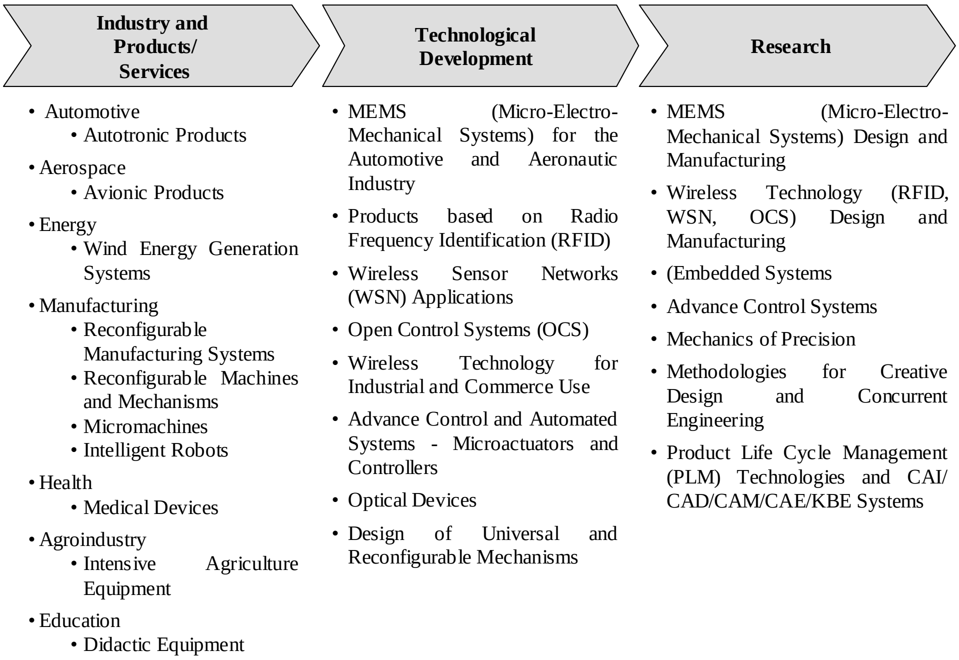

Fig. 7: Technological Research and Development at the Service of Industry in the Area of Mechatronics

Additionally, the National Development Plan and the State Development Plans were reviewed as highly important reference points to which the I + D + i^2 strategic programs should be associated in order to link the diversity of existing efforts towards building and developing the industrial sectors that may detonate the competitiveness of each region of Mexico with a huge economic, political, social and cultural impact for its inhabitants.

4 Internal context: The role of university

In the internal context of I + D + i^2 strategy of the Tecnológico de Monterrey, the "University" is considered as one of the key players in the promotion of socio-economic development in regions and countries because of its inherent capacity to promote the international competitiveness of enterprises based on knowledge, innovation and technological development through the creativity and entrepreneurship of its graduates, future employees and entrepreneurs, committed to the economic, political, social and cultural development of their communities, as well as to the sustainable use of natural resources. This approach changes the role of the University and links it more directly to the development of its region by:

(1) Instructing teachers, professionals and graduates in the skills needed to support industrial innovation.

(2) Creating new scientific concepts, methods and instruments for the industrial development and innovation.

(3) Facilitating and stimulating the creation of interactive social networks.

(4) Providing competitive intelligence to lead the technological research process for the region.

(5) Creating valuable knowledge for the society.

(6) Increasing the scientific and technological capacity for basic problem- solving.

(7) Supporting the creation of new enterprises (licensing, incubation, funding, technology parks, etc.).

(8) Promoting public policies for the scientific, technological and business development.

Based on these two contexts, the strategic programs of the Tecnológico de Monterrey are defined to support the I + D + i^2 strategy.

5 I + D + I^2 strategic programs of Tecnológico De Monterrey

The Tecnológico de Monterrey has defined five objectives for taking the I + D + i2 strategy from its planning stage to its implementation stage:

(1) Increase the scientific and technological research oriented at attending the social, economic, environmental, cultural demands and the transfer of knowledge at national level.

(2) Instruct researchers and PhDs based on national and regional needs.

(3) Increase interactions with the National and International Scientific System and its ties to the Productive Sector.

(4) Increase the research and development activities, as well as the innovation and incubation capacity of the productive sector through the technology transfer.

(5) Support and favor collaboration and cooperation between the key agents for the I + D + i^2 strategy to promote the creation and development of regional innovation systems, giving rise to the creation and distribution of wealth.

These objectives form part of the strategic planning conducted and supported in various strategic studies related to the international, national and regional context aimed at identifying strategic opportunities for development based on international best practices in innovation and the conditions existing in each of the regions of Mexico for the development and attraction of value-added and internationally competitive industries.

In order to achieve these five objectives, ten strategic programs have been identified for positioning the Tecnológico de Monterrey as the leading promoter of innovation, technological development and sustainable development in Mexico and Latin America:

(1) Human Capital Development

(2) Postgraduate Programs

(3) Research Chairs

(4) Centers for Excellence in Research

(5) Research Networks

(6) Technological Development Networks

(7) Industrial Support Networks

(8) Incubator and Accelerators

(9) Technology Parks

(10) Sustainable Campus

Figure 8 shows the holistic view of the I + D + i^2 strategy of Tecnológico de Monterrey for leveraging the regional competitive development of Mexico through the identification and incorporation of best practices for innovation and their adaptation to the national context for the creation and development of regional innovation systems capable of fostering knowledge transfer, technological and product innovation, and cultural change in regional industries towards achieving companies that are more competitive, better paid jobs and societies with a better quality of life.

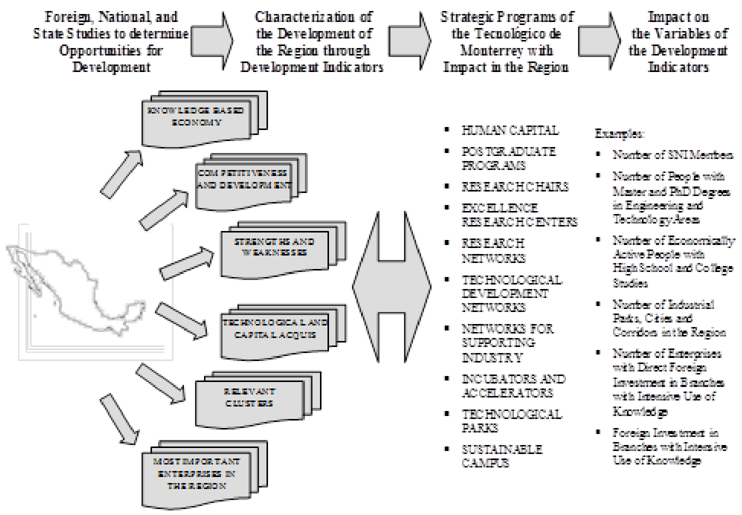

Fig. 8: I + D + i2 Strategic Programs and their Impact

This I + D + i^2 vision is characterized by its concrete actions aimed at impacting the key competitive development indicators of country and its regions (economic, political, social and cultural) through various strategic programs that broadly encompass the promotion of a favorable culture for innovation, the creation of conditions necessary for the generation of new industries/ innovative firms and their articulation in innovation networks, support for research focused on priority topics, and the education of professionals with an entrepreneurial spirit who are capable of boosting the production and innovation of Mexican enterprises in a socially and environmentally responsible manner.

Finally all these concrete actions will be monitored through a system of indicators that will follow up on the efforts carried out and successes achieved in terms of process indicators that show the gradual progress made and of impact variables that will show the contributions of each one of $I + D + i^2$ strategic programs to the regional competitive development of Mexico (See Table 6).

Program	Process Indicators	Impact Variables
Human Capital Development	Number of Students Graduated in Science and Engineering Number of teachers with PhDs Number of SNIs (Researchers) Academic Leaders at Campus, System and Strategic Level Number of Teachers participating in Strategic Programs	Population in High school and College Studies %PEA Economically Active Population that has received Training Overseas Entrances and Departures (per 1,000 Inhabitants) Average Education
Postgraduate Programs	Number of Students studying a Master's Degree Number of Students studying a PhD Degree Number of Students studying a Post-PhD Degree Number of Master's and PhD Programs accredited by CONACyT	EAP with Postgraduate Students Total Human Capital inventory in Science and Technology Postgraduate Students in Science and Technology Population with Studies in Informatics
Research Chairs	Seed Funds Invested External Funds Attracted Chairs Indicators (# of Publications, # of Patents, # of Licenses, etc.)	Resources awarded by CONACyT for Scientific and Technological Research per 1,000 Inhabitants Patents per 1 Million Inhabitants Scientific and Technological Production SNI members
Centers for Excellence in Research	Number of Research Chairs per Research Center Income from Research Income from Licenses Income from Extension Income from Enterprises Served	Resources awarded by CONACyT for Scientific and Technological Research per 1,000 Inhabitants Patents per 1 Million Inhabitants Scientific and Technological Production SNI members Enterprises Registered in the RENIECyT (per 10,000 Employers)
Research Networks	Number of Research Chairs participating in Research Networks Number of Research Chairs participating in Mega-projects (CONACyT, NSF, FP7) Number of Inter-campus Projects	Resources awarded by CONACyT for Scientific and Technological Research per 1,000 Inhabitants Patents per 1 Million Inhabitants Investments in Informatics and Agricultural Optimization Enterprises with IED in the Branches of Intensive Use of Knowledge as a % of Total Enterprises

Technological Development Networks	Number of Technological Developments (Functional Prototypes) Number of Campuses sharing Laboratories Number of Product Development Projects for Industry	Resources awarded by CONACyT for Scientific and Technological Research per 1,000 Inhabitants Patents per 1 Million Inhabitants Staff working in the Informatics Sector Production in the Informatics Sector
Industrial Support Networks	Number of Enterprises Served Income from High Added-Value Technological Services Incomes from Extension Services	Business Management Procedures Number of Enterprises with ISO9000 Economically Active Population that has received Training
Incubators and Accelerators Technology Parks	Number of Students and Alumni Incubating Enterprises Number of Enterprises Incubated Number of Enterprises Accelerated Number of Enterprises Attracted Enterprises' Invoicing Jobs Generated	IED per Capita Growth of added value per capita Total Labor Productivity (GDP/ EAP) Enterprises Registered in the RENIECyT (per 10,000 Employers) Enterprises with IED in the Branches of Intensive Use of Knowledge as a % of Total Enterprises
Sustainable Campus	Number of Campuses participating in the Program Number of Academic Programs that include the Concept of Sustainable Development in their Courses Reduction of Consumption of Resources per Person: Reduction of Liters Water/Person, Reduction of Cubic Meters Gas/Person, Reduction of Kilometers/Person Number of Student Community Projects with an Impact on Suitable Development	Enterprises Certified as Clean Annual Hazardous Waste Generation Annual Solid Waste Generation CO^2 Atmosphere Emissions Volume of Treated Wastewater

Table 6: Indicator Systems for the Impact of I + D + i2 Strategic Programs

The following are some specific actions that the Tecnológico de Monterrey is making within its I + D + i^2 strategic programs:

Human Capital Development:

› Attract national and international leading professors (Academic Leaders).

› Instruct professors to support the strategic topics for the country (Research Professors - SNIs and Entrepreneurial Professors). Create an information and competency development system for research professors and consultants.

Postgraduate Programs:

› Focus professors on meeting the priority topics of Mexico and its regions.

› Improve academic quality through national and international accreditations.

› Improve the efficiency of syllabi.

Research Chairs:

› Arrange the research chairs by priority research areas for the country.

› Guide the research chairs towards the priority research topics for the country.

- › Centers for Excellence in Research
- › Create centers for excellence in research to support the work conducted by research chairs.

Research Networks:

- › Create system-wide research chair networks at Tecnológico de Monterrey for the development of strategic projects for the country with an interdisciplinary approach, including the following areas: Biotechnology, Health, Regional Development, Design and Engineering, Entrepreneurship, Information and Communication Technologies and Public Policies for Development.

Technological Development Networks:

- › Create system-wide technological development laboratory networks to generate prototypes for potentially marketable technology-based products.

Industrial Support Networks

- › Create diverse centers for innovation and technology transfer aimed at supporting different industrial sectors, such as: Food/Beverage, Pharmaceutical, Agribusiness, Health, Automotive, Aviation/Aerospace, Electrical/Electronic, and Software.

Incubators, Accelerators and Technology Parks:

- › Create science and technological park models to integrate the research, technological development, incubation, acceleration and "landing" of companies.

Sustainable Campus:

- › Achieve sustainable operations on Campus.
- › Implement best practices for consumption and recycling.
- › Incorporate the concept of Sustainable Development in academic and training programs.
- › Perform disciplinary and multidisciplinary research.
- › Actively participate in the Conservation and Sustainable Development Chair.
- › Promote liaison activities with the community.
- › Disseminate and communicate the results and impact of program.

6 The Management Model Of The I + D + I^2 Strategy Of Tecnológico De Monterrey

The management model of the I + D + i^2 Strategy of Tecnológico de Monterrey is based-on the work carried out by Vijay Jolly (1997), which focused on the transformation of ideas into knowledge and, in turn, knowledge into new technologies through a process of innovation management that mobilizes ideas and resources for creating and commercializing new products, processes, services and technologies (See Figure 9).

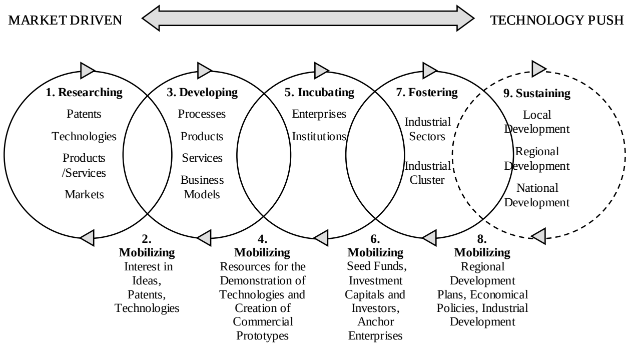

Fig. 9: I + D + i^2 Strategy Management Model

The management model for the I + D + i^2 strategy has five activities that constitute the key processes involved in bringing an idea to the market in the form of a new product and/or service focused on meeting an existing demand or need.

The first process is research, it depicts as a set of research and idea generation activities aimed at discovering ideas, concepts and innovative technologies with real market opportunities. The objective of this process will be to validate the added value of innovation in terms of its ability to meet the market needs and find a niche with high value in terms of economic and social benefits.

The second process is the development, which is the process of turning an idea into a patent for a prototype and the prototype into a product or service. This process is characterized by the need for resources for creating functional prototypes and demonstrating their functionality to potential customers and consumers.

The third process is incubation, which is only reached by the products that have proven their commercial potential and give rise to new companies responsible for their commercialization or technology transfer to trading companies. This process requires a considerable investment to create the new company and bring the new product and/or service to the target market.

The fourth process is foster, which seeks to maximize the impact of innovation by promoting its adoption in the market in order to increase its economic and social benefits. The main objective in this process is to accelerate the competitive positioning of a new company with its products and services in the domestic and international markets. The consolidation of productive chains, clusters and industrial parks forms are an important part of this process to foster the local and regional development.

The fifth process is sustain, in which a knowledge-based and innovation-based economy has been adopted by the region and is beginning to be used as a competitive advantage to ensure the creation and distribution of wealth based on the development of new companies, products and/or services.

Each of these activities and the passage of an innovation through them will require a series of sub-processes that address and support the I + D + i^2 strategic programs (See Figure 10) focused on the initial step of identifying the market and industry needs in terms of priority research and development topics for new products, processes, services and/or technologies as a creative process that adheres to the scientific method and conducted by the research chairs, center for excellence in research and innovation networks of the Tecnológico de Monterrey. In this way, ideas, patents and technologies will be mobilized to the next level of maturity known as a prototype (bridge between the research process and the development process).

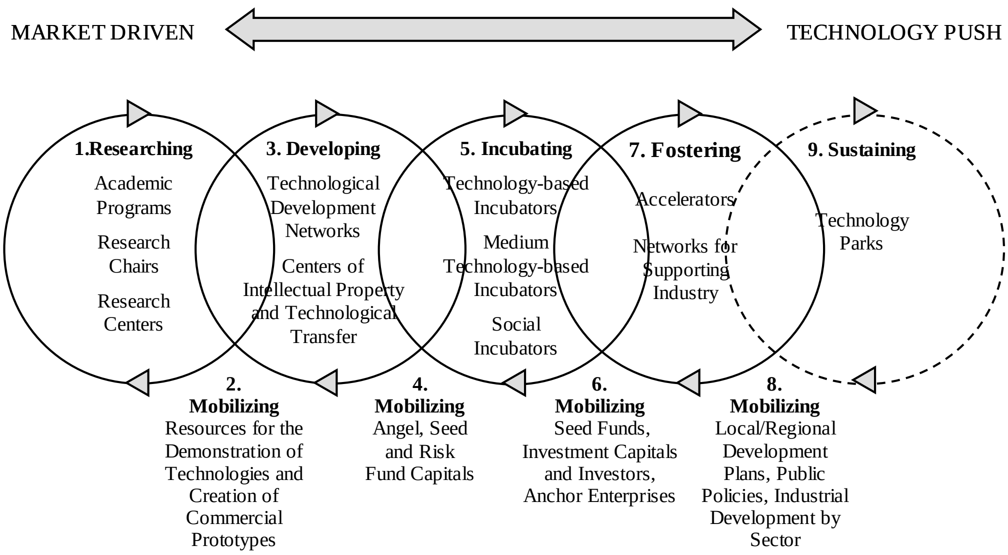

Fig. 10: I + D + i^2 Strategic Programs

The second step, as already mentioned, is a process that involves the development of commercial prototypes for their validation as an innovation in the market. This process takes place through technological development networks, as well as centers of intellectual property and technology transfer of Tecnológico de Monterrey that serve as technological partners and "beta users" of innovations in a feedback process to validate and improve innovations before they are patented and launched into the market (bridge between development and incubation).

In the third and fourth step, the products, processes, services and/or technologies that have proved their commercial value to the market should be commercialized through various schemes ranging from spin-offs, technology transfers or the creation of new enterprises for the commercialization of these innovations. In this sense, the Tecnológico de Monterrey has promoted and set-up business incubators and accelerators, as well as industrial support networks, responsible for such schemes (bridge between incubation and foster towards sustain).

Finally, the innovations are incorporated intothe various industrial sectors, through the creation of technology parks, to increase the companies' level of competitiveness and achieve their articulation in clustering schemes, such as regional innovation systems, in such way that the sum total of parts will be greater than the whole and a greater impact on local, regional and national development levels will be achieved through innovation.

7 The I + D + I^2 Strategy Results

The following section presents a general overview of I + D + i^2 ten strategic programs results towards the Mission and Vision 2015 of Tecnológico de Monterrey (See Table 7).

Program	Process Indicators	2006	2012
Human Capital Development	Number of SNIs (Researchers)	235	266
	Number of Post-doctorates	0	35
Postgraduate Programs	Number of Students studying a PhD Degree	358	673
	Number of Master's and PhD Programs accredited by CONACyT	22	47
Research Chairs	Number of Research Chairs	65	144
	# publications in SCOPUS	212	244
	Number of publications cited in SCOPUS	923	2,240
	# of patents filled	17	61
Centers for Excellence in Research	Income from Research	6.3 million of USD	23 million of USD
Research Networks	Number of Research Networks	1 in Biotechnology and Food Sciences	4 in Biotechnology and Food Sciences, Mechatronics, Sustainability and ICTs
Technological Development Networks	Number of Technological Developments (Functional Prototypes)	17	61
	Number of Campuses sharing Laboratories	2 campuses (Virtual Laboratories)	8 campuses (Virtual Laboratories)
Industrial Support Networks	Incomes from Extension Services	63 Million of USD	96 Million of USD
	Number of Industrial Support Networks	1 CEDIAM (Automotive)	8 CEDIAM. CEDIA, CILTEC, IGS, CDIS, IDESS, IMS, EEN
Incubators and Accelerators	Number of Enterprises Incubated	247	1,761
	Number of Accelerated Enterprises	0	30
Technology Parks	Number of Technology Parks	1	12

Sustainable Campus	Number of Campuses participating in the Program	1	31
	Number of Academic Programs that include the Concept of Sustainable Development in their Courses	1 course included in all the bachelor programs	100% of the bachelor programs include the concept of sustainable development along the curricula (transversal).

Table 7: general overview of I + D + i2 ten strategic programs results towards the Mission and Vision 2015 of Tecnológico de Monterrey

Human Capital Development:

The Tecnológico de Monterrey in numbers supporting its University mission of high quality education for human capital development, and research for knowledge generation (See Table 8 and 9):

Human Capital	2006	2012
Faculty recognized at National Researchers System	235	266
Post-doctorates	0	35
PhD Students	358	673
Publications in SCOPUS	212	244
References in SCOPUS	748	2,240
CONACYT Scholarships in millions of pesos	1	104
Teachers with a PhD degree	195	271

Table 8: Human Capital Development Growth

Totals	Human Capital (Accumulative Indicators)
104,197	Students
242,438	Alumni
8,549	Faculty
897	Teachers with a PhD degree
2,458	Researchers
266	Faculty recognized at National Researchers System

Table 9: Alumni, Faculty and Researchers Numbers

Postgraduate Programs:

The University postgraduate education offer includes nowadays 70 master programs (40 accredited by National Program of Quality Postgraduate Studies - PNPC) and 11 PhD degree programs (7 accredited by National Program of Quality Postgraduate Studies - PNPC) with national and international recognition (See Table 10).

Postgraduate Programs	2006	201X
Master Programs Enrollment (70 programs)	9,879	16,743 (2010)
PhD Programs Enrollment (11 programs)	358	534 (2011)

Table 10: Postgraduate Programs

Research Chairs:

The University researcher chairs include 136 research groups (2,458 researchers / 266 ranked at the National Researchers System) in the areas of Biotechnology and Food; Social Sciences; Regional, Social and Sustainable Development; Education; Humanities; Government; Entrepreneurship; Manufacturing and Design; Mechatronics; Nanotechnology; Business; Health; and Information and Communication Technologies (See Table 11 and 12).

Priority areas	Research Chairs	Faculty with SNI	PhD	Master	Undergrad
Biotechnology and Food	9	23	37	73	17
Social Sciences	13	37	78	150	23
Regional Development	6	25	3	27	
Social Development	3	15	26	48	
Sustainable Development	10	7	24	151	1
Education	5	5	62	473	
Entrepreneurship	3	2	6	81	2
Government	7	10	27	254	2
Humanities	10	28	87	28	
Manufacturing and Design	11	24	51	208	1
Mechatronic	10	14	48	176	62
Nanotechnology	5	11	23	41	37
Business	19	17	69	64	2
Health	6	15	22	90	
TIC	19	33	83	265	23
Total	136	266	591	2,129	170

Table 11: Research Chairs (2011)

No.	Research Accumulative Results (2006-2012)
271	Filled patents
794	Books
144	Research chairs
266	Faculty recognized at National Researchers System
673	PhD students
2,528	Papers in indexed journals

Table 12: Research Results

Centers for Excellence in Research:

The University research chairs have been organized around 56 centers for excellence in research conducting national and international research and consulting projects under individual and collaborative bases (See Table13):

Area	Centers for Excellence in Research
Biotech & Food	2
Health	1
Manufacturing and Design	10
TICS	10
Sustainable Development	4
Business	8
Government	20
Education	1
Total	56

Table13: Centers for Excellence in Research

Research Networks:

The Tecnológico de Monterrey developed presence, through its researchers, in the 20 thematic research networks of National Council for Science and Technology (CONA-CYT) (See Table 14).

CONACYT Thematic Research Chairs	
1. Water	11. Mathematical and Computer Models
2. Life Sciences	12. Ecosystems
3. Complexity, Science and Society	13. Poverty and Rural Development
4. High Energy Physics	14. Soft Matter
5. Energy Sources	15. Aging, Health and Social Development
6. Environment and Sustainability	16. Robotics and Mechatronics
7. Nanosciences and Nanotechnology	17. Hydrometeorological and Climate Disaster
8. New Medical Trends	18. Etnoecology and Biocultural Patrimony
9. Food, Agriculture and Biotechnology	19. Aerospace Scientific Research and Tech
10. Information Technologies	20. Civil Society and Democracy Quality

Table 14: CONACYT Thematic Research Chairs

Also, Tecnológico de Monterrey has launched four research networks on: Biotechnology and Food Sciences, Mechatronics, Sustainability and ICTs.

Technological Development Networks:

A National Technology Transfer Centers (Offices) Network was launched with presence in ten States (cities): Sonora, Chihuahua, Monterrey, San Luis Potosí, Estado de México, Ciudad de México, Puebla, Querétaro, Guadalajara and León, supporting the University's third mission of knowledge transfer to society (See Table 15).

No.	Item (Till 2012)
271	Patents requested at national and international level.
20	Patents obtained.
23	Spin-offs (star-ups) from research chairs.
13	Licensing deals
16	Brads registered.
1	Franchise.
61	Functional prototypes development
8	Virtual laboratories

Table 15: University Technology Transfer Actions

Industrial Support Networks:

The following eight networks of centers for industry development were launched (See Table 16 and 17):

Center	Centers’ Network Presence at National/International Level
Center for Automotive Industry Development (CEDIAM)	In five leading States (cities) recognized for their Automotive Sector: Toluca, Hermosillo, Aguascalientes, Puebla and Irapuato.
Center for Aerospace Industry Development (CEDIA)	In four leading States (cities) recognized for their Aerospace Industry: Querétaro, Sonora, Chihuahua and Monterrey.
Center for Trade and Logistics Innovation (CILTEC)	In five leading States (cities) recognized for their trade and logistics activities: Santa Fe, Toluca, León, Guadalajara and Estado de México.
Global Institute of Sustainability (IGS)	In two leading States (cities) recognized for their sustainability actions: Mexico City and Monterrey.
Center for Software Industry Development (CDIS)	In two States (cities) recognized for their Software Industry: Guadalajara and Monterrey.
Institute for Sustainable Social Development (IDESS)	With National presence, targeting small and social businesses.
Intelligent Manufacturing Systems (IMS)	With National and International presence (USA, Europe, Switzerland, Korea and Mexico).
European Enterprise Network (EEN)	With National and European presence.

Table 16: Industrial Support Networks

Year	No. of Projects (supported by CONACYT Innovation Programs)
2009	40
2010	72
2011	57
2012	41

Table 17: University-Industry Collaborative Projects

Incubators and Accelerators:

National Network of Incubators and Accelerators:

- › Intermediate-Technology Incubators: 25
- › High-Technology Incubators: 8
- › Business Accelerators: 16
- › Virtual Incubator: 1
    - › Incubated enterprises created by incubator network: 3,529 start-ups.
    - › Accelerated businesses: 1,375

Technology Parks:

National Network of Technology Parks: 12 parks.

- › Direct jobs in the parks: 4,870 jobs.

› Indirect jobs from the parks: 14,610 jobs.

› Landing 1,365 companies (30 foreign).

Sustainable Campus:

All 31 campuses of Tecnológico de Monterrey system act as living labs in where all research and technological development is tested for reducing the ecological footprint of campuses operations - Initiatives: Operations (reducing consumption, recycling, green areas, use of sustainable technologies); Education (teachers, students, staff); Research (sustainable technologies; resource management: water, energy, building y environment); community (influence and communication entailment).

8 Evolving the I + D + I^2 strategy

After the I + D + i^2 ten strategic programs deployment from 2006 to 2012 a new strategic planning exercise has been conducted following the framework proposed in Figure 1. Furthermore, during 2012 the Tecnológico de Monterrey conducted an evaluation of its 2006-2012 I + D + i^2 ten strategic programs and started the launching of new ones according to its 2012-2017 I + D + i^2 strategy. Some strategic programs will be or have been conserved and updated, and some others will be or have been already evolved targeting higher levels of quality in the University education model and higher levels of impact in the national innovation system and society (see Table 18).

<table>
<tr><th>2006-2012</th><th>2012-2017</th><th>Changes</th></tr>
<tr><td>1
Human Capital Development</td><td>1
Human Capital Development</td><td>Special focus on entrepreneurs and researchers development in addition to graduates and postgraduates.</td></tr>
<tr><td>2
Postgraduate Programs</td><td>2
Excellence in Academic Programs</td><td>Reduction and update of academic programs (graduate and postgraduate) focusing on new competences profiles according to industry needs and launching of a new education model based on experience learning, educational technology, entrepreneurship and internationalization.</td></tr>
<tr><td>3
Research Chairs</td><td>3
Research Chairs and Areas of Excellence</td><td>Reduction of research chairs, creation of new multidisciplinary research chairs and focus on areas of excellence (defined based on the national industry needs and opportunities vs. university talent and infrastructure to respond to them).</td></tr>
<tr><td>4
Centers for Excellence in Research</td><td rowspan="2">4
Legacy Projects</td><td rowspan="2">Re-organizing the research networks and technological development centers efforts towards the support of society and industry.</td></tr>
<tr><td>5
Research Networks</td></tr>
<tr><td>6
Technological Development Networks</td><td>5
Technology Transfer Centers Network</td><td>Rename of program, but same focus on intellectual property protection, knowledge transfer and technology commercialization.</td></tr>
<tr><td>7</td><td>6</td><td>New strengthening actions for the current industrial support networks</td></tr>
</table>

Industrial Support Networks	Industrial Support Networks	through international alliances (e.g. UC Berkley, Arizona State, Georgia Tech).
8 Incubator and Accelerators	7 Entrepreneurship Ecosystem	New ecosystem efforts for the entrepreneurs support to increase their start-ups mortality (incubators role) and businesses fast growth (accelerator role).
9 Technology Parks	8 Innovation Ecosystem for Regional Development	Evolution of technology parks role from high-value employment creators, attractors and developers of business and/or research facilities providers to regional innovation brokers.
10 Sustainable Campus		The sustainable campus program has reached its consolidation and will continue its successful operation.
	9 Institute for Sustainable Social Development	Social entrepreneurship and social development commitment has been upgraded as a new strategic program. NOTE: From 2006 to 2012 these social actions were part of incubators and accelerators program under the social incubators action.
	10 Industry Strategic Liaison	A new strategic program focusing on strengthening the University relations and strategic alliances with National and International economic-driven industries.

Table 18: Evolving the I + D + i^2

9 Conclusions

Nowadays, the universities play a fundamental role in the development of regions and countries. Therefore, in its new mission 2015, the Tecnológico de Monterrey is committed to developing the international competitiveness of Mexican companies and industries based-on knowledge, innovation, technological development and sustainable development.

The I + D + i^2 strategy of Tecnológico de Monterrey is a commitment to the competitive development of every region of Mexico based-on the research, development, innovation and incubation of Mexicans' ideas.

This commitment is demonstrated day by day with excellence in research on the country's and its states' competitiveness in the search for new development opportunities, and is ratification by the characterization of each region's development based-on the process indicators and impact variables that show accomplishments and the results already attained through the I + D + i^2 strategic programs proposed by the Tecnológico de Monterrey for each region of Mexico, in order to achieve the socio-economic impact desired by all Mexicans.

> *"The I + D + i^2 strategy of Tecnológico de Monterrey is a proposal for transforming Mexico into an innovative, internationally competitive country"*

Note: The paper should be considered as a practitioner research work (action-research), rather than a theoretical paper.

Acknowledgements

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The Evolution Of Science Cities: The Case Of Newcastle Science City

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Abstract
Within the economic geography literature, there has been research undertaken to gain an understanding of how science concentrations have developed. However, most of the research has been based on the listing of chronological events or is rather descriptive. More recently, attempts have been made to apply an evolutionary economic geography (EEG) framework to understand the development of science concentrations as it enables a better understanding of these developments as it provides a view on how processes of change operate over time. In light of this, this article utilizes an EEG framework to analyze how one type of science concentration, a science city, evolved over time. The case of Newcastle Science City (NSC) is analyzed from 2004 – 2011 utilising a qualitative approach. The findings shed light on the evolution of science cities, specifically highlighting that organizational restructuring, the establishment of new organizations and the stimulation of new connections between individuals and regional organizations facilitates the development of science concentrations.

Keywords
science cities; evolutionary economic geography; high-tech region; technopoles.

1 Introduction

In the context of the knowledge economy, science concentrations such as science parks, technopoles and science cities have demonstrated their important role in collecting capability and human resources, attracting venture capital and producing innovations (Anttiroiko, 2004). The ultimate goal of these concentrations is to bring about economic and business development to contribute to national economies (OECD, 2008b). Within the economic geography literature, there has been research undertaken to gain an understanding of how science concentrations have developed to reach their ultimate goals of economic development. Castells and Hall's (1994) seminal book Technopoles of the World is the first comprehensive survey to explain how they develop, what each aims to accomplish and how each manages to pass on the lessons to other regions. The other significant research comes from Anne Saxenian on Silicon Valley and Route 128 (Saxenian, 1994). The issues with the findings from this research is that "regional success stories (e.g. Silicon Valley and Emilia-Romagna) are often so much based on culture-based contingencies" and lack a theoretical framework "that transferring policies from these regions to other places is at best difficult'' (Hospers, 2006:10). Ignoring this issue, all over Europe there have been great efforts to construct 'Silicon Somewheres' (Florida, 2002) which has been an unsuccessful strategy for the above mentioned reasons.

However, more recently, there have been attempts to utilize the notions of EEG to better understand how science concentrations such as science parks have evolved (Garnsey and Heffernan, 2007, Quere, 2007). It has been suggested that an EEG approach enables a better understanding of these developments as it provides a view on how processes of change operate over time (Boschma and Martin, 2010, Boschma and Lambooy, 1999, Simmie et al., 2008). Key notions such as path-dependency, agglomeration and organizational adaptation are employed to analyze the development of these science concentrations. This latter research applying an evolutionary perspective has been more successful in providing a way to learn from 'best-practices' as it does not overemphasize the cultural aspects (Kenney and Patton, 2006a) or what Hospers (2006) calls 'culture-based contingencies'. Instead of emulating best practices or picking winners as a policy strategy, an evolutionary approach suggests building on regional competencies and acquiring sensitivity to local trajectories (Boschma, 2005b).

This paper analyzes the evolution of NSC, which is one of six government designated English science cities. Against the above background, the paper addresses the following broad question from an evolutionary perspective: How do science concentrations evolve over time? To address this question, this article aims to apply an EEG framework to the case study of NSC to help analyze how it has evolved since its designation in 2004. Specifically, structural change will be discussed to explain the endogenous manner of local actors to engage in collective action to establish new organizations, re-structure old organizations and build connections between organizations to support the objectives of NSC. There is no research to our knowledge which attempts to gain an understanding of science cities from an evolutionary perspective. Indeed, research on the development of science cities is often approached from a chronological perspective (Anttiroiko, 2004, Cabral, 2004). This paper attempts to fill this gap. In developing an understanding of the evolution of NSC, the article proceeds along the following lines.

In section 2, the theory of EEG will be discussed. Section 3 will introduce the case study methodology undertaken for this research. Section 4 will present the case study of NSC and its evolution from a structural EEG perspective. A discussion will take place in section 5. The paper will conclude in Section 6.

2 EEG conceptual framework

EEG stems from the early seminal work of Nelson and Winter (1982) and Dosi et al. (1988) on evolutionary economics and processes of regional growth and change. Boschma brought the evolutionary economics and economic geography literature together to create a more systematic theoretical framework (MacKinnon et al., 2009). According to EEG scholars, what has been lacking from existing theories such as 'the New Economic Geography' (Krugman, 1991) and 'Institutional Economic Geography' (Martin, 2000) is that neither approach explains how the landscape evolves over time (Boschma and Martin, 2010). The EEG approach aims to explicate regional change from the underlying industrial dynamics of firms (e.g. geography of entrepreneurship, innovation and extinction) (Boschma and Frenken, 2009) and the rise and fall of technologies, industries, networks and organizations (Frenken, 2007). More recently, the role of regional policy within an EEG framework has also been discussed (Boschma, 2011, Asheim et al., 2011). The key propositions of an evolutionary approach are based on concepts such as path dependency, co-evolution and structural change. For the needs of this paper, we are interested in evolutionary concepts around strategies of structural change at the level of organizations. According to Boschma (2005b) structural change involves the following: (1) restructuring the organizational framework and (2) stimulating new connections between (new) organizations; (Lambooy and Boschma, 2001:264, Boschma, 2005b). These strategies will be discussed in further detail in the below section.

2.1 Restructuring the organizational framework and the creation of new organizations

The discussion around organizations in the EEG framework is linked to the fact that the long-dynamics of economies in space and time are dependent on organizational arrangements and organizational change (Gertler and Wolfe, 2002). Indeed, there has been increasing attention towards how organizations can be included in the explanatory framework of EEG (Boschma and Frenken, 2009, Nelson and Winter, 2002, Pelikan, 2003) as they play a role in the dynamic developments of evolutionary paths (Strambach, 2010). According to Boschma (2010), regions build up different organizational environments over time which act as incentive and selection mechanisms. "Institutions affect not only the intensity and nature of relations, and, thus, the degree of interactive learning between agents in a regional context, but also the capacity of regions to upgrade, transform or restructure specific institutions required for the development of new economic activities" (ibid: 1008). What is important is whether organizations are flexible and responsive to change when required as this 'dynamic capability' affects the long-term competitiveness of a region.

New organizations as well as the restructuring of old organizations also helps transform the local environment for the development of new economic activities (Lambooy and Boschma, 2001). This is based on one of the two perspectives of organizations discussed in the EEG perspective which is that organizations primarily influence innovation in a generic sense and co-evolve with technologies over time and differently so in different regions (Boschma and Frenken, 2006:291). New organizations develop as new technologies are established. The processes of this change are not market processes but rather complex processes involving the forming of collective bodies, the decisions of voluntary organizations, government agencies and political action and involve the actions of industry associations, technical societies, universities; etc (Nelson, 1995). The other EEG perspective on organizations, which is less relevant for the needs of this paper, explains territorial differences primarily based on the differences in the history of firms and industries residing in a territory rather than solely on the organizational framework. Studies using an EEG approach may be interested in the history of a company founder and key employees and how their routines transferred from previous activity affects their survival (Frenken, 2007).

When looking to studies of organizational restructuring in the economic geography literature to explain the growth of science concentrations, there are various examples where the concept has been utilized. In the Cambridge high-tech cluster, apart from the endogenous process driven by spin outs and emerging agglomeration benefits, 'organizational adaptation' has been used to explain the development of the high-tech cluster (Garnsey and Heffernan, 2007). While originally Cambridge University did not provide active support for technology transfer, over time entrepreneurial academics helped transform the university into a more enterprising institution. The transformation within the research is not explained in detail but what this suggests is the importance of organizational change to help support local actors and the role this has on the development of science concentrations . This also links to Strambach's concept of 'plasticity of institutions' which refers to the "elastic stretch of organizations and organizational arrangements and their interpretative flexibility through actors" (2010:407). According to Strambach (2010), organizations may act as enablers where actors can recombine and convert or reinterpret organizations for their new objectives. Of course, the flexibility of the organization depends upon the type of organization. The evolutionary framework Strambach proposes aims to "endogenize the role of organizations, and makes organizations a more integral part of the explanation of the evolution of the economic landscape" (Boschma and Martin, 2010:24). In another example of organizational change in a science concentration, the Sophia-Antipolis science park organizational change took the form of a governance shift from a purely private to a public initiative (Quere, 2007). This governance shift helped to transform the Sophia-Antipolis from a 'City of Science' to an 'International Industrial Park' which helped to assure the sustainability of the project. In Silicon Valley, organizations and technological trajectories co-evolved to create an ecosystem for entrepreneurs (Kenney and Patton, 2006a).

2.2 Stimulating new vonnections between individuals snd tegional organizations

While the first feature of structural change from an EEG perspective focused on restructuring the organizational framework, the second feature involves further stimulating connectivity between new or restructured organizations at a regional level (Lambooy and Boschma, 2001) or in some cases of peripheral regions instigating the connections in the first place. Lambooy and Boschma (2001:261) argue that policies should "ensure that all organizations that make up the system span all the necessary range of activities (that is, none are missing or underdeveloped) and that these organizations interact intensively". This concept is based on the systems of innovation literature which stresses that innovation is interactive and involves various organizations including universities, research institutes, public sector organizations and firms (Cooke et al., 2000). It is the interaction between the knowledge generation and exploitation of sub-systems which leads to the commercialization of new knowledge (Cooke et al., 2004). Geographical proximity enables these organizations to interact and facilitates the exchange of tacit knowledge (Boschma, 2005a). The more intense the interaction between the different parts of the system, the more dynamic the system will be (Carlsson et al., 2002). Cooke (2005:44) further explains this in relation to Silicon Valley where he argues that Silicon Valley's success was not due to its focus on technology which many people suggest but rather that it was "the first place to systematize the process of interactive innovation". This systematization, Cooke (2005:47) goes on to explain was Silicon Valley's capability in "crossing boundaries" from knowledge exploration (laboratory bench) to knowledge exploitation (to the market). Stimulating new connections between organizations is also underpinned by the literature around networks. Saxenian (1990) analyzed local networks in Silicon Valley and concluded that they were essential for exchanging and sharing knowledge between individuals and regional organizations such as universities, trade associations, businesses, and venture capital firms.

The key question is how to coordinate these different organizations which reflect different cultures, have different objectives and respond to different incentive mechanisms (Dasgupta and Stiglitz, 1980). Some argue that government may have a role as a "broker" and network facilitator (Lambooy and Boschma, 2001). Informal networks amongst members of a common community of practice has also been discussed (Metcalfe, 1994). The transformation in the relationship between university, industry and government as key actors within the regional innovation system (RIS) is also a suggested strategy (Etzkowitz, 2003). According to Etzkowitz (2003:308), university, industry and government "enter into a reciprocal relationship with each other (mostly at the regional level) in which each attempts to enhance the performance of the other". The initial level of interaction is usually collaboration taking place through their traditional roles and typically begins via discussions to improve the local economy, develop a regional growth agreement, or establish a technology council. At a latter stage, each partner "takes the role of the other" while at the same time maintaining its primary role and distinct identity. Etzkowitz (2003) uses the example of government to demonstrate this point where government's main responsibility is providing the rules that govern society, it now also makes venture capital available to help start new enterprises.

EEG strategies of structural change	**Operationalized change strategies**	**Examples**
Restructuring the organizational framework and the creation of new organizations	Organizations are used by local actors to recombine and convert or reinterpret organizations for their new objectives.	Cambridge high-tech cluster – ‘organizational adaptation’ used to explain development of high-tech cluster (Garnsey and Heffernan, 2007) Sophia Antipolis Science Park – organizational change in the form of a governance shift from private to public initiative responsible for its continued sustainability (Quere, 2007) Silicon Valley – Technology and institutions coevolved to create an ecosystem for entrepreneurs (Kenney and Patton, 2006b)
Stimulating new connections between individuals and regional organizations	Stimulating new connections is also essential for building partnerships and exchanging and sharing knowledge between individuals and regional organizations.	Silicon Valley – systematized the process of interactive innovation through crossing boundaries between knowledge exploration and knowledge exploitation; local networks also essential for exchanging and sharing knowledge between individuals and regional organizations (Cooke, 2005)

Table 1: Conceptual framework

Based on the above review of the literature, our framework (see table 1) will be used to analyze the case study. The first column presents core strategies of structural change (restructuring the organizational framework and stimulating new connections between individuals and regional organizations) explicitly discussed in the above sections. The second column further explicates the structural change strategies. Restructuring the organizational framework can be seen when organizations are used by local actors to recombine and convert or reinterpret organizations for their new objectives. Stimulating new connections between individuals and regional organizations is a process that involves building partnerships and between individuals and regional organizations. The final column presents examples of other science concentrations and how EEG concepts were used to explain their development.

3 Research methods

The research design is based on a case study approach. Scholars utilizing an EEG framework acknowledge the value of utilizing case studies to analyze regional specificities from a dynamic perspective and as a tool in appreciative theorizing (Boschma and Frenken, 2006). The research methods stemmed from the methodology of Eisenhardt (1989). The advantages of this research approach include “the potential to generate theory with less researcher bias than theory built from incremental studies” (Eisenhardt, 1989: 546) and “the likelihood that resultant theory will be empirically valid” (ibid:547).

Research Methods	Data Sources
Observational analysis	30 NSC Team Meetings 10 NSC Regional Events 1 NSC Core Partner Meetings 1 NSC Communications Group Meeting 2 NSC Away Days 3 Six Science Cities Meetings
Document Analysis	NSC Prospectus for Development NSC Team Meeting Notes NSC Activity Reports NSC Vision Document Pre-Budget Report Leading the Way: Regional Economic Strategy OECD Reviews of Regional Innovation North of England, UK OECD Territorial Reviews Newcastle in the North East Innovation Nation NESTA Report Innovation and the City Realizing the Potential of the North East's Research Base Scientia^{08} Bright Purpose NSC Evaluation Newcastle in 2021
Semi-structured interviews	2 Professors of Practice 3 Newcastle University senior staff members 2 Newcastle University Business Development Managers 15 Newcastle University Academics 2 NSC senior staff member
Informal discussions	4 NSC senior staff members 1 CELS (The Centre of Excellence for Life Sciences) senior staff member 1 IPPR (the Institute For Public Policy Research) researcher 2 One North East senior staff members 1 NESCI (North East England Stem Cell Institute) staff member

Table 2: Research method and data sources

The research began by defining the research question: How do science concentrations evolve over time? A priori constructs were then taken from the EEG framework such as 'restructuring organizational framework' and 'stimulating new connections between organizations'. Multiple data collection methods were chosen involving observational analysis, document analysis and semi-structured interviews with actors in the chosen case study (see table 2). A case study approach characteristically joins data collection methods such as archives, interviews, questionnaires and observations and enables triangulation of evidence (Eisenhardt, 1989).

The observational analysis included attendance at key NSC team meetings, NSC regional events, NSC core partner meetings, NSC communication group meetings, NSC Away Days and Six Science Cities meetings. The document analysis involved the analysis of significant documents which provide information on NSC's evolution. Additionally, semi-structured interviews were conducted with actors within and working for NSC each lasting approximately 60-90 minutes. Audio recording was used during all interviews to maintain the original detail provided by the interviewees and to enable for transcriptions. Post interviews, the bulk of the data was transcribed by the authors to ensure in-depth emersion in the data (Ritchie and Spencer, 1994).

The interview data was analysed manually and followed the case study-based research approach including familiarisation, identifying a thematic framework, indexing or coding and interpretation or emerging theory (Eisenhardt and Graebner, 2007). The codes which were applied to the data stemmed from the research question, conceptual framework and a priori concepts (Miles and Huberman, 1984). Other themes analyzed across the interview data included 'roles of actors', 'research themes', 'change' and 'partnership' which complemented the a priori concepts and research questions. From the coded data, explanations were sought in order to address the core research question - How do science concentrations evolve? The findings were then compared with conflicting and similar literature to "build internal validity, raise theoretical levels, and sharpen construct definitions" (Eisenhardt, 1989). This process helped to shape hypotheses which were developed. These are presented in the discussion section. The next section will present the case study.

4 Case Study: NSC

This section analyzes the case study of NSC based on the observational analysis, document analysis and semi-structured interviews undertaken and is explained through the application of the EEG framework.

4.1 Background

A Science City is defined as "new settlements, generally planned and built by governments, and aimed at generating scientific excellence and synergistic research activities…within a high quality urban space" (Castells and Hall, 1994:39). Its policy purpose is to encourage a particular type of industrial activity, research and development, in locations where it would otherwise not take place (Appold, 2004) as a tool of regional development (Castells and Hall, 1994). The concept combines 'science' and an 'urban' setting where the 'urban' dimension refers to location, infrastructure, industrial and other services (Anttiroiko, 2004). Science cities have developed over the years and are categorized in the literature into three waves: 1st wave: purpose-built campus-based new towns; 2nd wave: large scale capital developments on the outskirts of existing cities; and 3rd wave: place science-based economic development within existing metropolitan areas (Charles, 2010). According to Castells and Hall (1994), there are key issues which shed light on science cities' genesis, structure and outcomes which are: successful synergy in technopoles involves a combination of innovations; in developing technopoles state-private sector relationships are characteristic of the mature capitalist state; the role of universities in helping to develop technopoles is important; venture capital goes increasingly where high-tech industry already is; critical synergistic effects depend on specific forms of social organisation and institutional support; and technopoles need enough time to grow and mature which may take 20 to 30 years.

NSC represents a third wave science city which was designated by the UK national government in 2004. It links most closely with the definition put across by the OECD (2008a:210) as “a delimited spatial area where science, technology and innovation is actively used to promote economic and business development”. Unlike first and second wave science cities, NSC is deliberately woven into a pre-existing metropolitan area (Newcastle upon Tyne), uses science (broadly defined) as a tool for regeneration, has a broader social mandate to deliver social objectives and tends to be more highly networked (Charles, 2010:136) . It is a bottom-up public-private partnership between three key local actors which will be discussed in detail in a following section.

Figure 1 provides an overview of the timeline of NSC’s evolution mapped against the EEG strategies of structural change discussed above. The timeline is divided into stages (stage I, stage II and stage III) from 2004 to 2011. These EEG strategies of structural changes will be discussed in the below sections.

4.2 Restructuring the organizational framework and the creation of new organizations

The first structural change which explains the evolution of NSC is the restructuring of Newcastle University into an ‘entrepreneurial university’.

Newcastle University

Newcastle University was first established in 1834 as a College of Medicine in Newcastle upon Tyne. Newcastle is the only city in England where

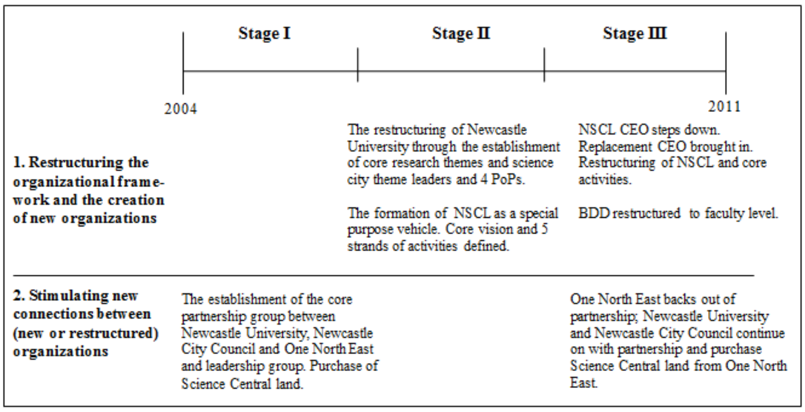

Figure 1: Timeline of NSC’s evolution mapped against EEG strategies of structural change

university teaching began in the faulty of Medicine so it has a long standing in scientific endeavors. It is part of the Russell Group of Universities and is known as a research intensive University with early roots as a civic university based on regional demands of the industrial economy. This concept of a ‘civic university’ resurfaced in 2007 with the newly appointed Vice-Chancellor at that time and has become part of its current aims and objectives to “play a leading role in the economic, social and cultural development of the North East of England” (Newcastle University, 2012). This aim is strongly linked to the reason for getting involved as a core partner of NSC which also has the goal to contribute to the economic development of the North East region. To respond to “the demand side of societal challenges” which is outlined as part of its ‘civic university’ objectives, the University recognized that it needed to make changes. Despite its history as a research intensive University, which suggests that it most likely would not be successful in contributing to NSC and its objectives (Castells and Hall, 1994), the University made changes to assume an entrepreneurial role in the initiative. When looking to the organizational changes within Newcastle University, they can be grouped into three stages which will be discussed in detail below: the emergence of the Business Development Directorate (BDD) (pre-science city designation), organizational changes (post-science city designation) and further BDD restructuring (post-science city designation). Stage 1 of the restructuring has also been included in the case study, despite its occurrence pre-science city designation, as the changes during this period affected Stages 2 and 3.

Stage 1: Pre-Science City Designation

The first stage of the structural change pre-science city designation involved the establishment of the BDD in 2003 which set the foundation for the University becoming ‘open for business’. Four business development managers (BDM) were appointed within the University at a faculty level based on the key research strengths of the University. This change was fundamental for the start of the commercialization of research as it was the first time that individuals within the University started to approach academics about their business ideas which is highlighted by a BDD Manager: “So basically they recruited four individuals with commercial backgrounds in the different areas of science. I started walking around talking to people and within about three days, I have a project list like this (raises hands out wide). I am not kidding it was scary. I was walking into places and they were saying ’oh, this is great you know we never had anybody come and talk to us about this before could you help me commercialize this’” (BDD Manager Interview, 2011).

Furthermore, the establishment of the BDD brought all business development activities under one umbrella and under one individual who led the unit. Prior to this change, it was recognized within the University that the pre-BDD unit activities were not successful in establishing Newcastle University on the trajectory of becoming an entrepreneurial university. As highlighted by a business development manager who worked at the unit during that time: “I think it (the quality of the BDD unit) changed. I like to think our team when we came in we were involved in changing that and there was recognition that it (the BDD unit) was suboptimal” (BDD Manager Interview, 2011).

Fundamental to the decisions around these changes was the Vice Chancellor (VC) who was a key actor who had the power to make changes at a high level within the University. The particular VC in charge of making changes was the start of the university's strategy to appoint VCs with experience in commercialization and entrepreneurship. This change had two effects. The first is that the VC made organizational changes to the University which included the formation of three large faculties and 27 schools to promote integration across the hierarchy. This restructuring made it possible for the University to adopt a more corporate response to opportunities in its external environment and helped the University rediscover its roots of "excellence with a purpose" (Goddard, 2008:15). The VC also had an effect on the ability of the university academics to spin-off companies as the VC provided support and encouragement for academics starting businesses. As explained by one academic:"I think the most helpful person at the early stages was the VC. In fact the VCs' which had knowledge of the company, I always found them to be very helpful…(through) conversations and encouragement" (Newcastle University Academic Interview, 2011).

The VC's support, encouragement and knowledge of the spin-off process stemmed from his past experience of starting his own company which according to a senior staff member of the University "counts for a lot in dealing with members of academic staff some of who took a lot of convincing that this was the right thing to do" (Senior Staff Member Newcastle University Interview, 2011).

Stage 2: Post Science City Designation

After the designation of Newcastle as a Science City, the University's commitment towards becoming an 'entrepreneurial university' continued which can be seen in its input towards the original prospectus of development for NSC which describes the transformation from a strictly research oriented organization to one which was "open for business and economic development" (Newcastle Science City, 2005). As described by the University: "By 'open for business and economic development', we mean the implementation of a model by which the University undertakes its activities in the closest contact with business and those concerned with the economic, social and cultural development of the Region" (Newcastle Science City, 2005:10).

To achieve this objective, the University started to make organizational changes which included: "The development of infrastructure, processes, behaviors, and financial and commercial arrangements that will break down the barriers between the University's expertise and business and the wider community" (Newcastle Science City, 2005:10). The transformation was made in combination with other stages of transformation the University was already going through (stage 1 discussed above) prior to the Science City designation. This involved "substantial organizational restructuring, new investment in areas of growth, breaking down traditional disciplinary boundaries, and exploring new approaches to business engagement" (Newcastle Science City, 2005:10).

In addition to the University adapting new processes and behaviors, it also developed its scientific research base. Four key research themes (Molecular Engineering, Energy and Environment, Stem Cell Biology and Regenerative Medicine and Ageing and Health) also known as 'societal challenge themes' within the University were identified based on existing regional strengths where there was major potential for growth in both scientific research and economic application. Each research theme was headed up by a 'science city theme leader' or successful Professor in the given area within the University. Since their inception, the key research themes have evolved. Along with the changes to the University's research base, the University hired four Professors of Practice (PoP) linking to the key research themes and established posts within the Business School. The PoPs were funded by One North East which was one of the core partners of NSC. These individuals all have PhDs and have worked or started businesses themselves in the four research areas which Science City is trying to develop. Their role within the University was "to serve as a role model for faculty members thinking about developing a start-up and, also as a link between the University's Business School and Science and Engineering Departments" (Dzisah and Etzkowitz, 2007:171). They were also encouraged to collaborate with the University's newly established 'science city theme leaders' to develop strategies and deliver Science City initiatives (ibid). From the University's perspective, the role of PoP correlates directly with its strategic mission of being "at the forefront of understanding business and professional practice and policy…and play a central role in the work being done by School and University for NSC" (Newcastle University Business School, 2011). According to a PoP, the role was more successful in two of the four research areas: "Of the four positions, I think two were reasonably successful and were continued…The two that were quite successful, energy and environment and healthy ageing they were already University institutes and people working in these areas and the two professors of practice who worked there just slotted into the existing framework" (PoP Interview).

Stage 3: Post Science City Designation

The third stage of the University restructuring involved the re-organization of the BDD unit for a second time. The restructuring of the BDD demonstrates that the University still needed to undergo structural changes in order to successfully reach its objective of becoming an entrepreneurial university. The new BDD unit was renamed to Research Enterprise Services (RES) and the structure changed from a centralization system to a faculty-based system in order to streamline activities. Three business development managers within the BDD unit were appointed to the three faculty levels within the University and act as a first point of contact for academics wanting to establish businesses. Academic leadership will come from the dean and professional/administrative commercial development team. The second structural change which explains the evolution of NSC can be seen in the establishment of Newcastle Science Company Limited (NSCL) which will be discussed below.

NSCL

In 2009, based on NSC's original prospectus for development, NSCL was incorporated as a special purpose vehicle to take forward the objectives of NSC on behalf of the three core partners. The creation of this new organization represents the partners attempt to establish permanent governance, accountability and delivery structures for NSC. NSCL established governance and a board structure made up of representatives from the core partners as well as developed a team structure including a Chief Executive, Finance Director, Program Director, Office Manager, Quality and Compliance Manager, Project Manager and Finance Manager. Establishing this new organization and appointing a Chief Executive of NSC to provide leadership within the initiative was important to the evolution of NSC as it was through his leadership that the initiative started to produce tangible outcomes to NSC such as science-based start-ups, engagement with schools in the region and the establishment of networks with local actors. This point was highlighted by a senior staff member at Newcastle University: "When the CEO arrived...he came with all sorts of ideas about how it (science city) could work and that was very helpful" (Senior Staff Member Newcastle University Interview, 2011).

NSCL established a core vision which the partners worked together across the region to achieve: "We are here to ensure the creation of prosperity from Science for Newcastle" (Newcastle Science City, 2009). Based on this vision and the original prospectus for development, NSCL established five core strands of activity which included: Science Partnership, the Newcastle Innovation Machine (NIM), Science Enterprise, Science Central and Education, Skills and Community. Overtime, that vision has changed as the partners have been able to further understand how the creation of prosperity from Science for Newcastle can be achieved. The vision has since then been adapted to the following: "Our mission is to promote scientific excellence, create and support innovative high-growth businesses and engage the local community so that everyone can become part of our city's continued scientific achievement" (NSC, 2011).

To support this further developed vision statement, NSCL also restructured the five core strands of activity and also changed some of the activities' titles. These structural changes were a direct result of the NSC partners and NSCL learning what it means to be a science city and the types of activities they should be undertaking. As explained by a senior staff member of NSC: "I believe because the organisation is only about 3 years old as times progressed we have learned and we have put in more systems and processes and we have identified opportunities where we can exchange our support activities and contribute towards what the partners really wanted" (Senior NSC Team Member Interview).

Most recently, it was announced that in response to financial challenges created by governments cuts to funding and the abolition of One North East, overall costs of the NSC will be reduced. Newcastle City Council and Newcastle University will continue to invest up to £500,000 each year in NSCL for the next three years. However, this reduction will change the future core activities of NSCL which is still yet to be known. The next section will discuss further structural changes which included stimulating new connections between these new and restructured organizations.

4.3 Stimulating new connections between (new or restructured) organizations

The third structural change involves the partnership formed between NSC's 'core partners'. These 'core partners' as they became known are: Newcastle University, One North East (the local regional development agency) and Newcastle City Council. While national funding was expected to follow the designation, no funding was eventually given to Newcastle. As explained by a senior staff member of Newcastle University: "The original belief was the government would back Science City with government money and some of that additional source of money would come to the University…Then it was realized after about a good couple of years, there is never going to be any money. Science City was a flag to fly. You are a Science City but there is not going to have government money flowing with it. I think at that point in time it all changed and people began to think 'well how are we going to get this as a source of money? How much money are we going to have to put in, what is the partnership going to look like. What are the returns to the partners going to be, how are they going to be determined?', and so on" (Senior Staff Member Newcastle University Interview, 2011).

As a result, the three key local organizations within the North East region established a partnership to take the science city designation forward. This partnership was established shortly after the science city designation and fostered communication between three very separate and different regional organizations stimulating new connections. According to research completed by Manford (2007), there was an inter-organizational pressure where no organization wanted to 'miss out' on the opportunity to participate in ensuring the successful achievement of Science City for Newcastle. The initial communication between the organizations was based around understanding what the designation meant for each organization, and how it could be best exploited for the benefit of the city and region. Each organization realized that the Science City designation could be utilized to achieve their separate developmental goals. For the University, the designation would enable it to continue achieving scientific research excellence. For the City Council and One North East, NSC would contribute to their regional development objectives.

The lack of funding provided by the government was important as it "forced" these 'core partners' to come together as a 'bottom-up initiative' and establish Newcastle as a science city based on local needs. The progress that NSC made in regards to bringing various stakeholders in the region together has been recognized by the government: "DIUS recognizes the progress that Science Cities have made in developing partnerships across a range of organizations, public authorities and businesses to achieve shared innovation priorities. The Science City Programme shows how science and innovation partnerships can work well across institutions” (DIUS, 2008:83 and 84). Despite the differences in the organizations and their objectives, all partners agreed to share one third of the responsibility and equally contribute financially to the initiative. For example, in 2005, one year after Newcastle’s designation as a science city, the partners purchased what had been the site of the former Newcastle Brewery to develop what is to become ‘Science Central’, a physical infrastructure for the urban incubation of science-based businesses. The ownership of the land was split in three ways. The partnership also established a Leadership Group led by Paul Walker, Former Chief Executive of SAGE Group Plc to drive the development of NSC. The Leadership group was also supported by a Task Group led by One North East and with membership drawn from Newcastle University, Newcastle City Council and a wide range of other key stakeholders. A ‘core partners meeting’ to discuss the activities of NSC takes place on a monthly basis and has attendance by all key local actors involved with the NSC initiative. More recently, in 2011, the partnership changed dramatically when One North East announced its closure. This announcement drove the two other partners, Newcastle University and Newcastle City Council, to consider future organizational changes as well as taking up the responsibilities of the third partner. As explained by the Newcastle University’s Vice-Chancellor: “Weathering that storm (the closure of One North East) will mean that we will make some organizational changes. We will restructure, we will adapt but we remain firmly committed to the vision as it has been set out originally by One North East and by the board of Science City and so on. When One North East goes out of existence at the end of the month the three way partnership will go back to a two way partnership in terms of the land at science central. We have had the approval now from London that we are committed now to buy, the city council and the University are committed to buy One North East’s share of that land which we will do” (Newcastle University Vice-Chancellor Scientia Speech, 2011). The Newcastle City Council Chief Executive also expressed his commitment to NSC: “My mantra certainly as chief executive of Newcastle City Council for the last two years has been let’s finish what we’ve started and this project is something that we will finish over the next decade or longer and that is important to us and we still see this as an investment priority” (Newcastle City Council Chief Executive Scientia Speech, 2011). The next section will discuss the findings from the case study against existing literature.

5 Discussion

Based on applying the above methodology through the lens of an EEG framework, we found that NSC’s evolution from 2004 – 2011 is based on structural changes at the regional level. Table 3 provides a summary of the existing literature, the findings from the analysis of the case study and hypotheses derived from the discussion. These points will be discussed in more detail below.

When analyzing the case study against the first strategy from the EEG framework (restructuring the organizational framework and the creation of new organizations), the first finding was that the restructuring of Newcastle University into an entrepreneurial university facilitated the development of NSC. This finding is similar to other studies on science concentrations that also highlight the role of university restructuring to facilitate the development of science concentrations (Anttiroiko, 2004 , Garnsey and Heffernan, 2007). However, in this study, the way the university was restructured is different. In the Anttiroiko (2004) study, it was demonstrated how the IT University in KISTA Science City (KSC) was restructured to strengthen the area's knowledge-base. The IT University's perspective on research was widened to new fields and to selected aspects of basic research. The university itself was increased in size to accommodate three times as many students and academic entrepreneurship along with the interaction between the university and IT firms was encouraged. In this study, Newcastle University's restructuring was less concerned with increasing in size but rather focused on joining up business development activities under one unit, promoting integration across the university, establishing core research areas under organised themes, hiring VCs with commercial experience and streamlining business development activities to further support academic spin-offs. In another study, Garnsey (2007) found that the university in the Cambridge high-tech cluster was restructured into an enterprising organization through the role of actors such as entrepreneurial academics and IT experts. Dissimilarly, this study found that the Newcastle University's restructuring was a result of senior actors within the University such as the VC rather than academics or IT experts which represents a top-down restructuring rather than a bottom-up restructuring. This first finding confirms what others also found which is that university restructuring facilitates science concentration development. It also suggests that universities are heterogeneous in their strategies of restructuring to become entrepreneurial.

The second finding was that the creation of NSCL, a new special purpose vehicle (SPV) organization, facilitated the development of NSC. Key regional organizations worked together to establish the SPV to achieve the objectives of NSC. This finding is similar to Anttiroiko's (2004) findings that KSC Ltd, a newly formed organization was also essential in KISTA's development. KSC Ltd. played a managerial and marketing function and a support system for technology start-ups. In this study, NSCL did not only play a managerial and marketing role as well as support technology start-ups, it also developed delivery structures for NSC to produce tangible outcomes such as engagement with schools in the region and the establishment of networks with local actors. This second finding also confirms what others found and links with what Strambach (2010) calls institutional plasticity which is when communities of actors recombine and convert or reinterpret institutions into various hybrid forms to serve new or modified goals or objectives. However, the finding also highlights that new organizations can also have a strategic role in achieving the objectives of science concentrations. Based on the above, the first hypothesis stemming from the research findings is:

Hypothesis 1: Organizational restructuring and the establishment of new organizations facilitates the development of science concentrations.

When analyzing the case study against the second strategy from the EEG framework discussed (stimulating new connections between individuals and regional organizations), this study found that a bottom-up partnership formed between three regional organizations (Newcastle University, One North East and the RDA) which contributed to the development of NSC. The partners worked together, shared one third of the responsibility and contributed financially to NSC. They developed the initial NSC prospectus which outlined the aims of NSC, established a leadership group and purchased land to develop the main infrastructure of NSC. Two of the three partners also supported each other when the third partner withdrew from the partnership as a result of being closed by governmental changes.

This finding correlates with the study by Anttiroiko (2004) who also found that KSC developed as a result of co-operation and 'negotiated order' between the City of Stockholm, big IT firms, real-estate companies and educational organizations. However, unlike the Anttiroiko (2004) study, this study explains in detail how the partners came together and how the partnership evolved. It can also be said that the NSC partnership facilitated the development of NSC by strengthening its nonexistent RIS .

This correlates with a study by Coenen (2007), who found that through various public-private initiatives, specifically NSC, the North East has strengthened its previously non-existent RIS. This is an important finding as it has been highlighted that old industrial regions will have weak RIS or "deficits with respect to organisations and institutions and a lack of relations within and between the subsystems" (Tödtling and Trippl, 2005:1206). However, in this case of an industrial region, it has been demonstrated that the North East region can overcome such limitations. In this study, the connections were formed between very different organizations with dissimilar objectives which are deemed highly unlikely in the literature by industrial regions. This leads to the following hypothesis:

Hypothesis 2: Stimulating new connections between individuals and regional organizations facilitates the development of science concentrations.

To sum up, organizational restructuring, the establishment of new organizations and stimulating new connections between individuals and regional organizations is related to the development of science concentrations that are characterized by autonomously and independently functioning knowledge centers into science concentrations that are additionally, also characterized by (a) cooperation, joint venturing and joint governance of and by these knowledge centers, and (b) integrates commercial firms and other public institutes in this cooperative setting. The next section will discuss some final conclusions.

6 Conclusions

The central aim of this article has been to address the research question of how science concentrations evolve over time. To address this question, this article applies an EEG framework to the case study of NSC to help analyze how it has evolved since its designation in 2004.The main findings demonstrate that NSC's development and evaluation is based on structural changes at the regional level.

The first structural change involved a newly formed partnership between three dissimilar organizations (Newcastle University, Newcastle City Council and One North East) as NSC's core partners which helped to stimulate new connections between existing organizations. The second structural change included the establishment of NSCL as a special purpose vehicle to take forward the objectives of NSC on behalf of the three core partners. This organization is what brought tangible outcomes to the Science City designation including spin-off companies, engagement with the local science community and the brand behind NSC. The third structural change was the restructuring of Newcastle University from a traditional research university to an entrepreneurial university including investment in areas of growth, breaking down traditional disciplinary boundaries, and exploring new approaches to business engagement. The findings contribute to evolutionary concepts around strategies of structural change at the level of organizations in a region and can contribute to the discussion surrounding bringing a theory of agency into EEG.

Based on these findings, some policy implications can be discussed. As it was found that science concentrations evolve around structural changes at the level of organizations in a region, policies may be oriented to transforming the local environment (Boschma, 2005b). Rather than just designating specific regions with 'a flag to fly', policymakers should provide guidance to designated regions on how to move forward and develop the designations into tangible outcomes for the region. Following Boschma's suggestions, policies on structural change should focus on the creation of new organizations and the restructuring of old ones to support the development of science concentrations. Policies should also encourage establishing connections between the newly restructured and created organizations. This can involve bottom-up partnerships between organizations with similar objectives and organizations that have sufficient funding to move forward with their objectives. According to Wolfe (2010), the ability to create effective linkages among relevant organizations and actors at the local and regional level is a key factor in the development of effective policy.

While an EEG framework is helpful for the needs of this paper, it does have limitations. The theory itself is still at an early stage of development whereby some of the fundamental concepts need more elaboration theoretically and empirically (Boschma and Frenken, 2006). Further research is required to verify the findings reported here. Nevertheless, a number of findings worth further exploration have been identified. An avenue for future research could be to continue to track the changes of a specific science concentration over time to analyze the evolution at a later stage of its development and to evaluate the roles and decisions of actors.

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Mapping Critical Technology And Market Indicators For Successful Exploitation Of Inventions

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Abstract

In this research project we identified critical technology and market indicators related to innovation projects derived from individual inventors in the Netherlands: incremental, radical innovations and disruptive innovations. Examples of critical success factors relate to e.g. market, technology, IP, finance, the inventor. The critical success factors were derived from scientific literature. Based on this information, a questionnaire was constructed and several inventors have been interviewed on the relevance of these success factors for the innovation process related to their specific invention. The results of these interviews are analysed using concept maps, and led to the development of a preliminary checklist believed to be instrumental as an intake instrument for novel inventions in need for an efficient exploitation strategy.

Keywords

technology, market, indicators, valorisation and inventions.

1 Introduction

Since 2006 an award is handed out to Dutch companies who brought an innovation to the market and a list of the Top 100 is published ("MKB Innovatie Top 100"). The award is, of course, very prestigious. But, as practice learns, not every innovation is successful (nor is and will be the innovations from the Dutch Top 100), but failure teaches us valuable lessons (e.g. Chiesa & Frattini, 2011; Frattini et al., 2012)), e.g.:

- about the factors that determine the successful exploitation of inventions;
- about how types of innovations are of influence on successful exploitation.

Based on those lessons learnt it ought to be possible to develop a tool to predict the commercial success of an invention. In this paper we set out to identify the factors to warrant successful exploitation of innovations and develop it into a tool that accesses the commercial value. We describe the results of a qualitative research project. Thereby it will answer the following questions: what factors determine the successful exploitation of inventions? Can those factors be connected to type of innovations?

Following this introduction, various models of innovation, its process and the different views on critical factors is discussed. The third section addresses the case studies, which were analysed at Leloux, Science and Business and their results. The conclusions of our survey and their recommendations are presented and discussed in the fourth section.

2 Literature review

Innovation is considered to be a major driving force behind competitive success (Schilling, 2005). Schumpeter was among the first to define ("we will simply define innovation as the setting up of a new production function. This covers the case of a new commodity, as well as those of a new form of organization such as a merger, of the opening up of new markets, and so on" – Schumpeter, 1939: 84) and to identify the importance of innovation (e.g. Harvey et al., 2010); he distinguished five different types of innovation: new products, new methods of production (processes), new sources of supply, opening and exploitation of new markets, and new ways of organization. Others identified, almost always based on Schumpeter, different types of innovation, such as 'technological innovation'.

Garcia and Galantone (2003) also emphasize that the 'innovation' process comprises the technological development of an invention combined with the market introduction of that invention to end-users through adoption and diffusion, and that the innovation process is iterative in nature and thus, automatically includes the first introduction of a new innovation and the reintroduction of an improved innovation. This iterative process implies varying degrees of innovativeness and thus, necessitates a typology to describe different types of innovations. Schilling (2005) distinguishes 4 dimensions of innovation:

2.1 Architectural and component innovations

A component innovation (or modular innovation) entails changes to one or more components of a product system without significantly affecting the overall design. An architectural innovation entails changing the overall design of the system or the way components interact.

2.2 Competence enhancing and competence destroying innovations

Competence-enhancing innovations build on the firm's existing knowledge base. Competence-destroying innovations render a firm's existing competencies obsolete.

2.3 Product and process innovations

Product innovations are embodied in the outputs of an organization's goods or services. Process innovations are innovations in the way an organization conducts its business, such as in techniques of producing or marketing goods or services.

2.4 Incremental and radical innovations

The radicalness of an innovation is the degree to which extent it is new and different from previously existing products and processes. Incremental innovations may involve only a minor change from (or adjustment to) existing practices.

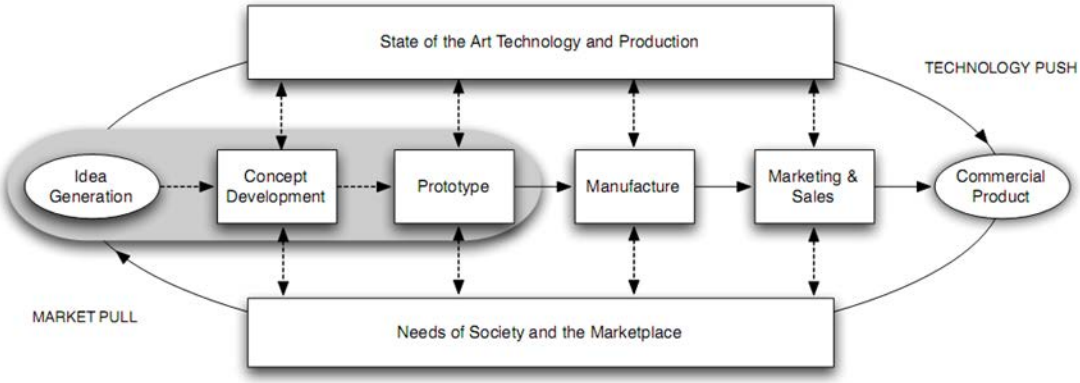

Figure 1: Interactive Innovation Model (Hobday et al., 2011)

In our project, we focus on incremental and radical innovations. Using the 2 dimensions of market and technology, four domains are being identified (Figure 1).

In addition, the innovation process is being described as interactive growth models, such as the simultaneously coupling-model, rather than linear innovation models, e.g. based on either technology push or market pull The simultaneously coupled-model is based on the interaction between three elements: Research and Development, Manufacturing and Marketing and explains how they lead to a commercial product (figure 2).

The chances for commercial success of an innovative technology have been discussed in the literature (Table 1). Heslop et al. (2001) uses a set of four factors believed to affect the commercial success or failure of the new technology and its transferability and commercialization. These are: the strength of the technology itself, the market attractiveness, commercialization avenues and management support. Galbraith et al. (2006) suggest that a reasonably good predictive model for commercial success of innovative products in companies can be constructed from organizational and technology factors, such as firm size, stage of development, and strategic partnerships. Panne et al. (2003) developed a model based on technology viability, linked to both firm related factors and project related factors, on one hand, and commercial viability, linked to product related factors and market related factors on the other hand. Lin et al. (2007) integrates technology readiness (TR) into the technology acceptance model (TAM) thus substantially broadening the applicability and the explanatory power of either of the prior models. This may be a better way to gauge technology adoption in situations where adoption is not mandated by organizational objectives. Cooper (1999) identifies two types or classes of success factors. The first deals with doing the right projects; the second with doing projects right. Doing the right projects is captured by a number of external or environmental success factors, over which the project team has

Author	Factors
Heslop	strength of the technology: Patentability; Patent search completed and clean; Confidentiality maintained; No pending publications; Existence of functioning prototype; Type of innovation: major breakthrough technologies, core technology improvements, state-of-the-art defining technologies market attractiveness General marketability for immediate or future uses; Existence of definable markets; Identification and quantification of benefits; Advantages over competing products; Absence of strong competitors; Measures of market size and growth rate; Market accessibility; Absence of entry barriers Commercialization avenues Form of transfer: identification of prospective licensee, spin-off company or technology sold outright; Financial aspects: access to venture funding or government-sponsored development research, cost of prototype development and marketing, expected ROI and Net Present Value Management support Inventor-related: previous success in developing transferable technologies, credibility and recognition of the inventor in his/her field; Institution-related: availability of skilled people and management
Galbraith	Technology category; age of firm ; number of employees; education level of technology team; diversification; total previous funding for technology; partnerships; stage of technology development.
Panne	Firm-related factors: Firm culture, Experience, R&D team, Strategy towards innovation, Organisational structure, R&D intensity Project-related factors: Complementarity; Management style; Top management support; Product-related factors, Relative price, Relative Quality, Innovativeness, Technologically advanced, Market-related factors, Concentration of target market, Timing market introduction, Competitive pressure, Marketing
Cooper	Solid up-front homework – to define the Product and justify the project. Voice of the customer – a slave-like dedication to the market and customer inputs throughout the project. Product advantage – differentiated, unique benefits, superior value for the customer. Sharp, stable and early product definition- Before Development begins. A well-planned, adequately-resourced and proficiently-executed launch. Tough go/kill decision points or gates –Funnels not tunnels. Accountable, dedicated, supported crossf unctional teams with strong leaders An international orientation – international teams, multi-country market research and global or “global” products.

Table 1: Success factors for successful exploitation of novel technology, as exemplified in the literature

little control. These include characteristics of the new product’s market, technologies, and competitive situation, along with the ability to leverage internal competencies. While not within the control of the project team, these are nonetheless useful factors to consider when selecting and prioritizing projects. Success factors emphasizing doing projects right, focus on controllable and discretionary process factors or action items – things the project team does (or too often doesn’t do). Cooper defines the “controllable” success factors as – the eight common denominators of successful new product projects. Based on the critical success factors identified in Table 1, we developed a novel list of those, forming the basis for our inventory. In Table 2 an overview of this list is presented. We started a qualitative research project to investigate the applicability of identified success factors. We decided to further investigate/predict the chances for success for a few cases involving novel technology as invented by some inventors in The Netherlands. The critical success factors such as identified in Table 2 form the basis for the questionnaire. Relevant stakeholders, such as the inventor, the patent attorney and the technology transfer consultant involved in the exploitation project of the novel technology were interviewed. The interviews were roughly based on the questionnaire developed, but the course of the interview and the exact content varied. Following this approach, the underlying pattern in selective choices of the interviewee might become visible (Saunders et al., 2006).

This underlying pattern might be expected to give some indications in the factors that would really be determining for the type of innovation. The results from the interviews were analysed by coding and represented in a concept map: a schematic representation of all factors and sub factors.

3 Case studies

In this paragraph four different inventions are investigated following the approach such as introduced in the upper section.

3.1 Second generation biomass pretreatment method

This patented invention (granted patent application EU…) from a Dutch individual inventor deals with a pre-treatment process for biofuel production, based on alkaline hydrolysis of lignine-containing ingredients of biomass, where acid hydrolysis is usually being explored. This pre-treatment method should be integrated in an existing biofuel production process, and needs thus to be compatible with it from a technological point of view. As related technologies are present, and a market exists (although still under development), this innovation can be classified as an incremental innovation in an existing market, and thus low risk. The use of this novel pre-treatment method should result in a more cost-effective and rapid biomass-based production method for biofuel: as the pre-treatment method targets lignin-cellulosic, which is usually difficult to digest, novel forms of biomass raw material (shrubs, garden waste) are accessible for biofuel production using this novel approach. Also, integration of this pre-treatment method in a process, which is functionally related, will not be too expensive. Therefore, the added value of this novel pre-treatment method in both financial and functional domains is positive. This technology is in an early development stage; only feasibility in laboratory experiments on pilot-scale has been demonstrated. For a successful exploitation of this novel technology, a proper fit with the technology base of the adoptive party is crucial, and therefore the selection of such developmental partners. Indeed, a wide variety of developmental partners exist, differing in their technology platform for biofuel production. Market conditions are moderately favourable as market trends into sustainable energy exist, and governmental support is usually available supporting further development and integration. E-cooking

The novel invention of the Dutch company IXL Innovation BV, e-cooking, is a patented novel platform technology to use to cook food. The technology involves the use of high-pulse electric fields and ohmic heat for rapid heating by electroporation of animal and vegetable cells. The result is a very tasteful cooked food with high nutritional value against an extremely short cooking period, better microbial safety (as heat distribution within the food product is fully balanced) and reduction of energy. This technology is in an early phase of development with several prototypes being available and demonstrations with professional users being organized by IXL. This novel invention can be regarded as a high-risk disruptive innovation, as both technology and market changes are needed for a successful adoption of this technology by both professionals and consumers. The results of our interviews revealed that at least three types of added values are associated with this product. Due to logistic simplifications or less food waste by using the e-cooker in a professional kitchen, this innovation may be associated with financial advantages. The main functional advantages are the increased speed of the cooking process as well as the better taste, better presentation (e.g. cooked fish) and presumptive higher nutritional value of the cooked product. The societal advantage is the larger safety of the cooking process as well as the lower use of energy. This novel cooking technology fits in novel lifestyle trends, such as cooking everywhere, healthy cooking, sustainability (less energy use) and higher degree of individualizations. Several market segments can be approached using this technology, in all cases relevant business cases should be made.

3.2 Range-extender

The patented range-extender (PCT) from a Dutch inventor relates to a rotary machine for compression and decompressions and the construction of compact (electrical) pumps, compressors, turbines, combustion engines and generators for use in electric vehicles. This invention can be regarded as a radical innovation as the engine to be used doesn’t yet exist, but markets (electrical vehicles) exist. The range-extender can be applied to increase the action radius of an electrical vehicle (= functional added value). Due to this asset, electrical driving value). The financial added value is in the estimated relatively low costs of the final quite compact product (lower raw material costs). Proof-of-concept is currently being demonstrated and a prototype is now being evaluated to verify its claim of 98% of theoretical efficiency. For a successful exploitation of the range-extender, market-dependent parameters such as selection of market segments related to technological parameters, and its fit to such technology-market combinations are key. The market of electrical vehicles is still under development, and adoptive parties in these fields may still have a conservative attitude towards innovation from outside.

	Biomass pretreatment	e-cooker	Range-extender	Orthopedic prostesis
Type of innovation	Incremental: minimal technology change in existing market, low risk +	Disruptive: radical technology creating a new market, high risk -	Radical: radical technology change in an existing market, moderate risk +/-	Radical: radical technology in a sutainable market, moderate risk +/-
Market & commercially related factors	Market conditions are moderately favourable Technology fits into current market trend Market is large and growing Several adoptive partners are available Adoptive partners will need additional funding Time-to-market is relatively short +/-	Several market segments, large and growing market Technology fits in novel market/lifestyle trends Improved safety, low energy use (sustainable) Entrance barriers exist (user access to high pulse frequences) Large network of potential adoption partners available Time-to-market seems to be substantial +/-	Several adoption partners should be available, that seem however to be conservative (not invented here) Several market segments, large and growing market Technology fits into current market trends Time-to-market is moderate Competitie position may not be optimal (other solutions are also under development) -	Only few adoptive partners exist (niche market) Large entrance barriers (e.g. health insurance), CE marking is needed (has not been done yet) Network in professionals practice (reintegration doctors) exists Market size is limited, niche market exist -
Technology readiness	Prototype-phase Technology fit with adoptive partner is crucial Technology can be standardized Technology is novel and inventive +/-	Prototype-phase, demonstrations to professionals Breakthrough technology, first-to-market Development time seems to be substantial Production seems tob e feasible +/-	Prototype-phase, theoretical background is still weak, development time may be substantial Technology fit with adoption partner is crucial Investment in technology development and process integration is needed -	Prototype is available which has already been used in practice for 3 years Some single users exist Theoretical and scientific background is underdeveloped Design needs to be improved Development time can be relatively shortshort +/-
Financial issues	Reduce cost of competitive technology Investment in technology for process integration is moderate Governmental funding is available Potential high ROI, NPV +	Reduce cost of competitivecooking technologies (lower energy costs) High investment needed for development and marketing Relative price of first products are high Potential high ROI, NPV +/-	Reduce cost of competitive technology Investment in technology development and process integration is needed Relative price is expected to be low Potential high ROI, NPV Investment should be accessible fort his invention (sustainable solution in transportation) +/-	Price of product is higher than conventional products, while performance should be better Investment in CE-marking will be substantial Investors interested in this project can easily be identified +/-
Intellectual property	Granted EU patent (strong) ++	Patent position is potentially not so strong +/-	Patent position seems to be adequate +	Patent position seems to be adequate +/-
Inventor	Inventor with moderate entrepreneurial experience, realistic ambitions, good communicative skills +	Entrepreneur, realistic ambitions, good communicative skills, large network, good access to funds ++	Inventor with entrepreneurial skills, realistic ambitions, good communicative skills, large network, limited access to funds +/-	Inventor with entrepreneurial skills, realistic ambitions, good communicative skills, large network, good access to funds +
Success for exploitation	Sufficient +	Moderate +/-	Low -	Moderate +/-

3.3 Orthopedic prosthesis

This patented foot prosthesis (…), named Flexiwalker, from a Dutch inventor can be regarded as a radical innovation as its biomechanical features are radically different from the currently used graphite carbon orthopaedic feet, being the dominant technology in the market. From a competitive standpoint, the Flexiwalker is more expensive that currently used carbon-based prosthetic feet, but less expensive that the newest electronic prosthetic feet, whereas its user satisfaction (less pressure on the amputated stump and thus less exhaustion and possibility for longer term walking) seems to be superior. Thus the societal added value of this novel prosthesis is that more amputees could increase the quality of their life using this novel prosthetic foot. However, in healthcare market, entry barriers for novel medical equipment is very high as adoption by the professionals (reintegration specialist) and reimbursement by health insurances is key for an effective implementation of innovations. Also, a costly and time-consuming CE-registration is needed to create such access.

The current prototype should be further designed and developed. For instance, the theoretical and scientific base for the claimed biomechanical aspects is underdeveloped. Relevant market factors are the small market size, the relative high price of this product, and market entry barriers such as the absence of CE-marking and the lack of transparency of the decision making units in this market, e.g. adoption of this prosthetic foot by orthopaedic specialists and health insurances.

4 Conclusions and recommendations

The results of the literature study and case studies showed that success for different types of innovations depend on five critical domains such as: 1. Market-related and commercial factors, 2. Technology-related factors, 3. Financial issues, 4. IP-related factors and 5. Inventor-related factors. Based on this outcome we have been able to develop a convenient checklist for novel inventions, to be used as a diagnostic intake tool to further guide the exploitation process (Table 2). The analysis of the four cases in view of this checklist revealed different weight of the various parameters from the checklist. For the biomass project (incremental innovation), technological factors such as process efficiency optimisation were the key. For the radical disruptive innovation E-cooker, a sound exploitation strategy as various product-market combinations can be developed and consumer behaviour will change as a result by using this technology, is key. For the range extender, a radical innovation in a sustainable market, technological factors are the key. Finally for the Flexiwalker, a radical innovation in sustainable market, both technological (i.e. price, performance) and market factors (i.e. characteristics of the healthcare market) are key. More differentiated cases within the different innovations should be studied following up this checklist approach.

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Challenges Of Brokerage Functions In The Beginning Of The Innovation Process

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Abstract

An organisation's ability to innovate its products, services, processes or way of doings is important for its future success. The open innovation highlights the role of networks in innovation processes, suggesting that organisations rely heavily on their interaction with users, suppliers, and with a range of other organisations inside the innovation system. By integrating different kinds of actors into the innovation process, creativity and know-how is brought into the organisation. In these networks the diversity of resources is essential. The formation and functioning of these kinds of innovation networks can be problematic because of the existence of several challenges between innovating actors. These challenges between innovating actors may be so great that a special interpretation function is needed – brokerage functions. In this study, the focus is set on investigating the challenges of brokerage functions in the beginning of the innovation process. The research questions are: what kind of challenges there are in the beginning of the innovation process and how these challenges may be turned to innovation possibilities by brokerage functions. The theoretical part provides the background for brokerage functions. The empirical data used in this study is from on-going MOTION! project which aims to develop the exercise and well-being industry, and create models for cooperation between the private, public and third sectors. As a result the study presents challenges of brokerage functions. The study classifies cognitive, communicative, organisational, cultural, social, temporal and political challenges that are essential to take into consideration when planning brokerage intervention. In addition, the study introduces the concepts of internal and external brokerage functions.

Keywords

Brokerage functions, challenge, diversity, innovation.

1 Introduction

Developing successful new innovation requires collaboration among people from different areas of expertise brought together in groups or teams and belonging to one or several organisations. The collaboration between heterogeneous actors triggers creativity and gives possibilities for innovation by allowing the development of new ideas which could not have emerged in isolation. This is because the collaboration between heterogeneous actors allows drawing upon additional expertise (Burt, 1992) and accessing additional knowledge (Zhang, Baden-Fuller, and Mangematin, 2007). At the same time, collaboration with different actors breaks up established paths (Gerybadze, 2004) and thereby avoids getting trapped in lock-in situations (Boschma, 2005). Interaction between heterogeneous knowledge bases in an organisation and with the external knowledge bases is necessary in order to experience the effect of diversity, but the presence of relevant knowledge does not imply that the inflow of new ideas into the organisation is an automatic or easy process.

The differences between the innovating actors are often so large that a special interpretation function is needed – brokerage functions (Burt, 2004). Brokers support innovation by connecting, recombining, and transferring to new contexts pools of ideas that would otherwise be disconnected (Verona, Prandelli and Sawhney, 2006). Whilst spontaneous cooperation between organisations can occur, it appears that a brokerage intervention can help cooperation, for example, by advising on the advantages of cooperation, giving information, identifying opportunities, catalysing discussions between different actors or bringing organisations together. (Shaw, 1998.)

This study is interested in what kind of challenges there are in the beginning of the innovation process and how these challenges may be turned to innovation possibilities by brokerage functions. The empirical data is from on-going MOTION! project which aims to develop the exercise and well-being industry, and create models for cooperation between the private, public and third sectors. The development is especially challenging in this project because the network of actors ranges from groups within the public sector's social and healthcare services as well as educational services to third sector organisations and companies in the sport sector.

In this study, first the brokerage functions and their role in innovation activities are explained. This chapter is based on literature review. The third chapter introduces the case study as research strategy and empirical data. The analysis of the data and discussion are introduced in the fourth chapter. Summary of the study and further studies are presented in the last chapter.

2 Brogerage functions

In the literature, a great number of functions are attributed to brokers (van Lente et al., 2003). Howells (2006) made an extensive review of the existing literature and came to identify the following functions: foresight and diagnostics; scanning and information processing; knowledge processing and combination/recombination; gatekeeping and brokering; testing and validation; accreditation; validation and regulation; protecting the results; commercialization; and evaluation of outcomes. In his case study of an organisation that manages a program of triple helix projects, Johnson (2008) defined broker functions in terms of roles and speaks about the roles of mediator/arbitrator, sponsor/funds provider, filter/legitimator, technology broker, and resource/management provider.

According to van Lente et al. (2003), there appear to be three basic functions for brokers: demand articulation, network composition and innovation process management. Demand articulation comprises the diagnosis and analysis of a problem and the articulation of the needs of the organisation. This could include, for example, providing advice on what the client company should do in the future with regard to analytical activities or how it should react to a changing environment (Howells, 2006). Uotila (2008) sees it as important that knowledge brokers actively seek contacts and tap into organisations carrying out foresight processes and constantly seek information produced in foresight processes worldwide.

Network composition refers to making external relations available to an organisation. This means the scanning, scoping, filtering and matchmaking of sources of complementary assets such as knowledge, material and funding (Howells, 2006; Kolodny et al., 2001). Brokers help to access the variety of tangible and intangible resources that are needed to realise an innovation (Smart, Bessant and Gupta, 2007). Burt (2004) suggested that brokers focus on establishing ties to other disparate or disconnected groups, so they can then bring together members of the two groups who would otherwise be more difficult to connect. In her study of global intellectual capital brokerage, Törrö (2007) underlines that the services of a broker are needed when the access to the other party is missing. Companies consider brokers to be helpful when trying to establish unobvious ties in broader networks to develop or absorb new technologies, commercialise new products or simply to stay in touch with the latest technological developments.

Innovation process management primarily relates to enhancing communication, learning and other forms of interaction, and alignment among partners facilitates the attribution of intellectual property rights and the commercialization of innovation outcomes (Klerkx and Leeuwis, 2008). Innovation process management is the process of creating an atmosphere that stimulates knowledge sharing and learning, enabling a fair distribution of the costs and benefits between innovation network members and anticipating and resolving conflicts between the members (Batterink et al., 2010). Brokers are also defined as the holding glue keeping the network together by taking care of day-to-day network management issues, enhancing trust and resolving conflict (Kingsley and Malecki, 2004).

The broker’s role is essentially that of an interlocutor: to help other actors transfer, translate or transform the meanings encountered during joint activities (Carlile, 2004). A broker translates knowledge created in one group into the language of another so that the new group can integrate it into its cognitive portfolio (Kimble, Grenier and Goglio-Primard, 2010). There may also be information gaps. Actors are imperfectly informed about possible cooperation partners and what these can offer, i.e., there exists information asymmetry (Bougrain and Haudeville, 2002). To manage this, brokers must be able to manage the relations between individuals as well as act as translators. The broker’s role is a delicate balancing act. To be effective, brokers need to have authority within all of the groups to which they belong. They need to be able to evaluate the knowledge produced by the different groups and to earn the trust and respect of the various parties involved. (Kimble, Grenier and Goglio-Primard, 2010.)

The application of different brokerage functions depends on the requirements of the innovation network in the different phases of its development (Boon et al., 2008) and the composition of the network in terms of tie density and strength (Winch and Courtney, 2007). For example, in the early stages of innovation processes brokers contribute to reducing uncertainty when there is a high risk of failure, which would preclude private parties from innovating. Brokerage functions are not necessarily applied in a linear fashion. It may be necessary to re-articulate demand and re-compose networks during the innovation process (Sapsed, Grantham and DeFilippi, 2007; Jonhson, 2008). Sapsed, Grantham and DeFilippi (2007) show in their study that the effectiveness of brokerage activity depends on the brokerage capabilities.

Brokerage functions can be targeted at individual firms and clusters or networks of firms. At the organisational level, brokerage enhances the dynamic capabilities of the organisation in markets characterized by rapid changes. Additionally, brokerage functions can also be targeted at innovation systems that involve complex constellations of business, government, and societal actors, dealing with complex problems. (Klerkx and Leeuwis, 2009.) Hekkert et al. (2007) have proposed several functions which brokers could contribute for innovation systems, such as knowledge diffusion through networks, guidance for the search of knowledge, resources mobilization, and creation of legitimacy/counteracting resistance to change. At the innovation system level, innovation brokers create connectedness within the system and new possibilities and dynamism within a system, acting as catalysts (Howells, 2006; Sapsed, Grantham and DeFilippi, 2007; Johnson, 2008).

3 Research strategy

3.1 Case study

Case study is a preferred strategy when the investigator has little control over events, and when the focus is on a contemporary phenomenon within some real-life context. Thus, the distinctive need for case study arises out of the desire to understand complex social phenomena. Importantly and specifically, case study is the method of choice when the phenomenon under study is not readily distinguishable from its context (Yin, 2003). This study on the challenges of brokerage functions is a context-sensitive and complex one in which multiple variables need to be studied simultaneously. As Stake (1995: xi) emphasizes: “A case study is expected to catch the complexity of a single case … We study a case when it itself is of very special interest. We look for the details of interaction with its contexts … coming to understand its activity within important circumstances.” As Yin (2003) argues, the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events.

3.2 The case

The need for health enhancing sports activities has increased dramatically in the past decade. While the amount of leisure exercise has increased, there has been a marked decline in occupational, transport and household physical activity. These have contributed to increasing obesity and declining physical condition. A resident who does not get enough exercise for his/her health, who is overweight and who is in poor physical condition is at a higher risk of falling ill and thereby creating social welfare and health care expenditure for the local authority. Physical activity is fundamental in improving people's physical and mental health. It reduces risks of many diseases. Thus, different kinds of innovations both in public and private sector are needed to encourage physical activity.

The study builds on the on-going MOTION! project which aims to develop the exercise and well-being industry, and create new collaboration models for co-operation between the private, public and third sectors. The project's key measures are creating the exercise clinic service platform and piloting it together with the public, private and third sectors, ensuring the quality of services provided by the exercise industry in the health and exercise service chain, developing well-being entrepreneurship by using cluster operational models, developing new business models for the well-being industry through innovation and strengthening collaboration between sectors through networks.

The empirical data of this study consists of development sessions and surveys. The project has organized three development sessions for the experts of the health enhancing sports, one session for sports counsellors and two sessions for nurses and physiotherapists. For representatives of the exercise companies one session and service design course have been organized. These sessions have been observed by the researcher. Notes of the researcher and the material generated in the sessions have been analysed to define challenges that hinder co-operation. In addition, data include surveys to doctors and nurses about their attitudes and experiences of health enhancing sports as a medicine.

4 Challenges of brokerage functions

According to the data there are several challenges in the beginning of the innovation process. These challenges could be classified to cognitive, communicative, organisational, cultural, social, temporal, and political.

Innovation often requires dissimilar, complementary bodies of knowledge. Cognitive diversity will increase the likelihood that creative new knowledge emerges. (Boschma, 2005; Nooteboom et al., 2007). In this case study the cognitive challenge was related to missing expertise. For example, sport service providers had no knowledge or experience about the demands of inactive people. They also considered that it was difficult to market their services for inactive people because “they have no expertise in marketing”. In the public sector there were expertise about health enhancing sports and inactive people but the shortage of the employees made it difficult to use this expertise. It is essential that brokers consider what kind of knowledge is present and what kind knowledge is needed in the innovation process.

Too little of cognitive diversity means lack of sources of novelty, while too much cognitive diversity implies problems in communication (Nooteboom et al., 2007). In this case study the expertise in public and private sector was so different that there were misunderstandings. For example, some concepts like basic service of municipality or exercise services were understood differently. One participant even noticed that "doctors and sport counsellors are not speaking the same language".

An ability to communicate and exchange ideas is an important part of innovation processes. The innovation partners' success in reaching a common vision, exchanging creative ideas and evaluating them depends on the ability to devise a shared language, which is an essential asset in developing a common understanding. Sharing of a common language facilitates people's ability to "gain access" to other people and the information that they possess (Nahabiet and Ghostal, 1998).

Innovation depends also on a capacity to coordinate the exchange of complementary pieces of knowledge within the organisation and between organisations. Organisational challenge refers to the difficulty in coordinating transactions and exchanging information within and between organisations. According to the data it is difficult to share information in "too large organisations" and especially when "roles are unclear". Some pointed also that some organisations or teams are "withholding of necessary information".

Knowledge sharing is also difficult if "development teams are too small and tight and new members are not welcome". Organisational proximity is believed to be beneficial for innovations, because new knowledge creation goes along with uncertainty and opportunism. To reduce these, strong control mechanisms are required and hierarchical organisation or tight relationships within the organisation can provide solutions to these problems. However, too much of organisational proximity is accompanied by lack of flexibility. There is a risk of being locked-in in specific exchange relations. Search for novelty often requires going out of the established channels. (Boschma, 2005).

Economic relations are to some extent always embedded in social contexts, and social ties or relations in turn affect economic outcomes (Boschma, 2005; Granovetter, 2005). Social proximity may facilitate the exchange of tacit knowledge, in particular, because of trust-based relations. According to the data "envy, prejudice and fear prevent co-operation in the networks". On the other hand, too trust-based relations may weaken the innovative capacity of organisations. One participant of the workshop said that there are "secret development teams that do not tell what they are doing or invite outsiders to the teams". Closed network systems may incur opportunity costs because outsiders with new ideas and knowledge are denied entry. Long-term relations or relations with too much commitment may lock members of social networks into established ways of doing things at the expense of their own innovative and learning capacity. (Boschma, 2005.)

Every organisation and even its subunits have a culture of their own, which influences the ways in which its members think, feel and act. In the workshops it was noticed that there are still many organisations or departments that “never tries anything new because they are such a stick-in-the-mud”. Also “I do know myself” attitude inhibits common development activities in the organisations. In many organisations there were tendency that employees prefer working with those who they know very well and who thinks like they themselves. That way “diversity is not valued”.

The temporal complexity is related to, for instance, how organisations perceive future and how they use their networks to get weak signals (Parjanen, 2012). Innovation is often considered to be path-dependent. This path-dependency may lead to lock-ins to existing production and systems (Pihkala, Harmaakorpi and Pekkarinen, 2007). In the workshops in was noticed that “public and private sectors operate temporally differently” and that may hinder common development. It also takes time before new ways of doing are rooted to organisational routines. Temporal challenge may also be related to the fact that employees are “too busy with the routine work that they have no time to develop their work”.

There may also be political challenges that may affect development activities. In this case study especially decisions of the municipal councils were considered important. These could either support or hinder development of health enhancing sports. For example, the decision to close the sport committee in one municipality made it more challenging to speak for the benefits of exercise in this municipality. This also implies that it is important to inform different stakeholders in the region.

5 Conclusions

The diversity perspective on innovation emphasises the importance of the connectivity of a heterogeneous group of actors. The formation and functioning of these kinds of innovation networks can be problematic because of the existence of several challenges between innovating actors. In order to use these challenges as an innovation potential, there is a growing attention to having brokers to facilitate innovation processes (van Lente et al., 2003).

To answer these challenges there may be need to different kind of brokerage – internal and external. Internal brokerage is needed inside the organisation where different challenges create problems in communication, knowledge sharing and innovation. Internal brokerage creates possibilities for innovation by promoting open communication and knowledge sharing between different departments and communities of practice in the organisation, including everybody in the innovation process to present challenges or suggest new ideas, bringing different kinds of expertise together to solve common problems and by creating a climate that facilitates creativity and innovativeness.

The challenges of an internal broker are related to the fact that people usually perceive in their environment things which strengthen already existing matters or ways of doing. In organisations, things are often done in a familiar manner. This is especially true if the operations have been successful in the past. In innovation processes, it is central that the internal broker gets people to perceive things in a new way.

The external brokerage functions relate to the providing of the links, knowledge sources and tools so that organisations can accelerate and increase the effectiveness of their innovation processes. For example, brokers may build different kind of arenas that are based on diversity. Because of the heterogeneity of the participants, it is crucial to establish a trustworthy atmosphere, which helps different actors to overcome their reluctance to take part in an innovation process. If there is no trust, divergent perspectives and ideas will not be shared.

Brokerage as a delicate act (Kimble, Grenier and Goglio-Primard, 2010) includes taking into account many factors related to an organisation's cultural readiness to open innovation. It is essential that brokers together with representatives of the client organisation(s) consider and figure out the possible challenges and potentials for brokerage functions, available resources and the vision of brokerage intervention. In addition, brokers should also consider what kinds of skills and capabilities are needed in the intervention.

For the success of brokerage functions it is essential that organisations have possibilities to use brokers in their innovation activities and are willing to use them. This means that brokerage functions should be made a visible and essential part of regional innovation activities. It is essential how well the actors of the regional innovation system and the innovation actions themselves are known, and how well the actors know other actors contributing to innovation systems outside the region. Brokerage functions are supported by active communication networks both inside and outside the region.

This study belongs to the beginning of the innovation process. For further studies it would be interesting to study how brokerage functions differ during the innovation process. Challenges may indeed be differently accentuated during the various stages of innovation processes, and this may change the character of brokerage. Further studies could also concentrate on how brokerage functions differ in different types of innovation processes, for example, differences in product and service innovation processes.

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Vietnamese Higher Education Responsiveness Toward The Needs Of The Industry: Impact Evaluation Of The POHE Projects And Questions For Developing University-Industry Interaction

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Abstract

Profession-Oriented Higher Education (POHE) is a joint Vietnamese-Netherlands project (Phase I: 2006 - 2009 and Phase II: 2012 -2015) which aims to improve the responsiveness of Vietnamese universities toward the needs of the industrial sector of society by incorporating labor market needs into the curriculum development process and education delivery. The innovation that this project has brought to the Higher Education (HE) sector in Vietnam was to focus on the required competencies, skills and knowledge for specific professional orientations with special attention toward training in professional best-practices.

The purpose of this report is to provide an overall assessment of the results and impact achieved in Phase I and how these achievements can be consolidated and expanded in Phase II against the backdrop of overall reform of Vietnamese HE. The report places emphasis on institutional perspectives in context of greater autonomy being provided with the passing of a new law on higher education.

The implementation of the POHE programs in Vietnam is a timely response to the demands of HE reform. Curriculum design was accomplished by investigating the diverse requirements of the World of Work (WoW) and translating those demands into classroom modules. This was perceived as the dominate intervention that greatly improved the quality of training toward the needs of employers. Promoting the POHE curriculum as highly practical with assignments involving workplace-learning apparently sets the POHE programs apart from 'normal' training programs.

The POHE from 2006-2009 was considered a pilot program while its expansion from 2012-2015 will enable institutionalization and systematic innovation. Central to its success will be the linkage between education and the WoW. It is therefore strongly recommended that the following central interventions be made to all projects: (i) student demands and employability, (ii) interactions with WoW, and (iii) developing a legal framework and other schemes that will help create an ecosystem for developing university-industry interactions.

The new higher education law passed in early 2013 was to formalize and integrate earlier piecemeal measures taken to reform HE. In this paper we took the university perspective required to operate within a new environment and policy framework. This report will also provide an initial analysis of the contextual and internal factors that affect the development of university business cooperation (UBC) in Vietnam. Based on these observations, the authors proposed questions and recommendations aimed at producing more effective and mutually beneficial interactions between universities and industries specifically in the context of Vietnam.

This report is based primarily on qualitative research methods. The authors conducted field trips that engaged in in-depth interviews and extensive discussions with key persons in eight universities who implemented the project. They included university leaders, administrators, teachers, and students. Local business people were also interviewed, especially the HR staff of the industries.

Our major findings suggest that: (i) significant achievements from the Phase I POHE project were successful innovations in professional orientation through teaching and curriculum modification based on interactions with the WoW, (ii) barriers to expansion and up-scaling of these achievements were mostly governance and administration issues at different levels; and (iii) contextual and internal factor analysis provided some logic, explanations and leads to recommendations for strengthening university-industry interactions. This included suggestions for a favorable legal framework and calls for further studies on creating an ecosystem that will enable deeper engagement between universities and the World of Work.

The development of UBC relationships is a corner stone of the POHE project; this educational approach helps the HE system to become more responsive and provides an opportunity for Vietnamese policy makers to find a new balance within the HE system. The POHE approach also encourages universities to better define their own mission when they are given full autonomy and become more entrepreneurial. Overall, the POHE project provides information for looking at a larger overall picture of relationships between universities and industry in Vietnam.

Keywords
Vietnam, POHE, higher educational reform, student employability, university business cooperation.

1 Introduction

Vietnam is one of fastest-growing economies in Southeast Asia with a population of approximately 90 million and is now classified by the World Bank as a ‘lower middle-income’ economy. Vietnam’s GDP per capita has increased from $400 US in 2000 to $1,540 US in 2012. Alongside economic growth, Vietnamese HE has experienced a tremendous increase in enrolment during the last two decades. The total number of students in tertiary education in 2012 was 2,183,000 that is 16 times the number of students enrolled in 1997. The HE enrollment rate per 10,000 people reached more than 200 by 2010. However, significant challenges in educational quality still remain. According to a local study on employability at five key universities, only 50% of university graduates actually found jobs within 5 years after completing their degrees . An international company conducted interviews with 5000 applicants with the expectation of hiring 2000 new employees. The company ended up with 96 successful applicants in which only 40 applicants where capable of speaking English well . The relatively poor employability resulted from the huge gap between industry needs and the training quality of the HE sector. Employers seek quality from university graduates especially in terms of soft skills, language capability, creative and critical thinking, team work experiences, etc. While university management has slowly responded to the public, the Vietnamese government adopted a Master Plan for HE and Strategic Planning during 2012-2013, which identified a multi-tier system of higher education and that 70-80% of all students are expected to enroll in profession-oriented universities. Preparing these institutions for better responsiveness toward the needs of industry is an urgent need. A new Law on HE that will take effect in 2013 also provides for greater autonomy in schools creating space at the institute level to develop effective relationships with business.

The Profession-Oriented Higher Education Project (POHE) is conducted by the Vietnam Ministry of Education and Training (MOET) and is supported by the Netherlands Organization for International Cooperation In Higher Education (NUFFIC) and is a timely response to this need in Vietnam.

The core of the POHE concept is to improve career options for students and their employability by developing study programs which are responsive to the WoW as their primary guiding principle. Within the framework of the project, ten new POHE study programs were developed and initiated at eight Vietnamese universities:

› Hanoi University of Agriculture
› Hue University of Agriculture and Forestry
› Hung Yen University of Technical Education
› National Economics University
› Nong Lam University - Ho Chi Minh City
› Thai Nguyen University of Agriculture and Forestry
› Thai Nguyen University of Education / Faculty of Foreign Languages
› Vinh University

At the end of the project more than 3,000 students were enrolled in the study programs redesigned with support from the POHE project.

From a nation-wide and system-wide perspective, the implementing of the POHE project should be viewed as a pilot program to inform and provide best practices for HE reform at the policy and institutional level. As Phase I of the project was completed in 2009, and Phase II (2012-2015) began, a summative evaluation was conducted by the project team to make an assessment of the results and impact achieved in Phase I. The report not only included the achievements, challenges and barriers, but also an analysis of the factors that affect successful implementation of profession-oriented higher education in Vietnam. The first section of this paper briefly presents observations of the summative evaluation report. The challenges and obstacles to be seen in Phase I also raised questions that call for more study to strengthen university-industry interactions and cooperation for mutual benefits, which will be addressed partly in the second and third section of this paper.

2 Methodology

The overall research question is: "What are the major achievements and obstacles in implementing Profession Oriented Higher Education in Vietnam? What can the project do about effectively scaling up POHE programs; and, at a policy level, strengthening the interactions between universities and industries for better employability of students? Will the planned increased autonomy of universities lead to the development of new institutional perspectives on what mutually beneficial relationships between universities and businesses look like in Vietnam?

To address these issues, a group of five experts conducted interviews and focus group discussions with eight university stakeholders, including leaders/ administrators, faculty and students. Other informants quizzed by the team were entrepreneurs and employers. During these field trips, the observations of five experts were recorded. The research team also gathered information from other sources such as the press, interviews with ministerial officers, university profiles and so on. A workshop for eight participating universities was held later on and the initial findings were presented to gather feedback.

3 Findings

3.1 Overall assessment of POHE I:

Achievements from POHE I – were successful innovations in profession orientation through teaching methodologies and curriculum modifications. Encounters with professionals and employer representatives to discuss the workplace needs for professionals have given the POHE university teams a strong impetus to change their curricula. This has led to incorporation of the demand for topical knowledge and training methods aimed at stimulating skill and attitude development. The WoW engagement in the development and delivery of the curriculum was judged as an essential factor and a great contributor to successful changes. The WoW exposure for students was noted as transforming student learning, giving students a sense of professional development goals and career benefits. The interaction required a long lead time in shaping the readiness of the WoW to cooperate with universities; this effort took a toll on the project teams.

Curriculum design was perceived as the dominating intervention during POHE Phase I, requiring the most effort and yielding the most visible results for POHE I. Investigating the very diverse demands of the WoW and translating these demands to each curriculum required the need to integrate a wide range of teaching methods, re-aligning courses, sequencing and clustering of subjects and serious adoption of workplace-and practice-based learning. The design process appeared to be well understood and documentation was widely available. Now that the universities have developed and taught the full curriculum and the first reactions from internal and external stakeholders are trickling in, the redesign of the curriculum including teaching approaches and students' performance assessment appears to be on the mind of all respondents.

The authors held extensive discussions with all eight universities on the role of POHE in meeting the needs of society, especially business. The discussion results pointed out that presenting POHE as being highly practical with assignments involving workplace learning apparently sets the POHE programs apart from 'normal' programs in terms of providing students useful knowledge, skills and experiences. Among employers, the POHE graduates are of higher value and provide a lesser risk in employing them.

3.2 Favorable conditions, challenges and obstacles

The review of POHE I enabled a look at the factors (both positive and negative) that impacted the process of implementation of the POHE programs at the university. The analysis of these factors will help set long-term strategic planning in order to improve UBC in implementing professionally oriented education in Vietnam. The comments below are based on information collected through interviews and discussions with project teams at eight schools, program managers in MOET and the available quantitative data.

From a management perspective, these factors can be classified into two main groups: contextual factors (such as policy settings, socio-economic contexts, cultural effects, etc.) and internal factors of the university itself (such as university vision and strategies, organizational culture, management structures and internal policies, quality and availability of personnel, etc). Figure 1 is an overview of the factors that affect the POHE programs.

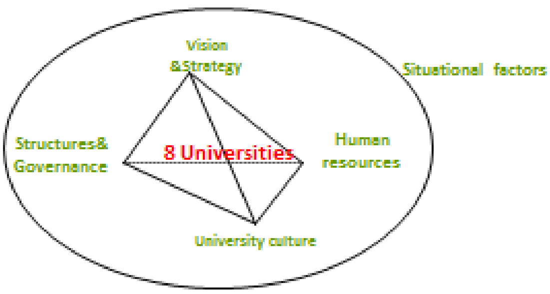

Figure 1: Influencing factors affecting POHE – an analytical framework

3.3 Contextual or situational factors

Favorable policy environment: At a national level, the ruling Party and the State expressed a clear orientation toward training according to the needs of social development[iii]. It can be said that the national framework enables a favorable policy environment for promoting university business cooperation and POHE programs. However, in reality, such a vision lacks sustaining policies that help translate the political wills into practice.

The new Higher Education Act which took effect on January 1, 2013 stipulates the responsibilities of industries for training of human resources for the country. The new law also grants a higher level of autonomy to higher education institutions so that universities may have more room to grow. Schools now can make most curriculum decisions on their own although several activities are still under centralized control.

Degree-oriented mindset is a common belief in society that focuses on degree-attainment rather than on true knowledge and skills acquired. Many people are pursuing university degrees for the degree itself. Students appear chasing degrees, not true knowledge and skills needed for the labor market, therefore HEIs appear chasing the student market, not the labor market nor the research market. POHE programs focus on soft skills, practical projects, and group work which emphasizes practical knowledge and skills rather than pure academic theory. This educational approach is more costly and requires more effort from the university while the public in general is not truly aware of its values in addition to the degrees. The culture of “degree orientation” hinders understanding the benefits of the POHE programs as an educational approach that helps close the gaps between university training and the needs of the WoW.

Restrictions on tuition fees: POHE tuition fees for the programs, as with other traditional programs, are restricted by the government. The low tuition fees allowed do not cover the cost of POHE program training which requires smaller class sizes for emphasizing practical soft skills, internships, group work, etc.

3.4 Internal factors that affect the development of the POHE programs at the university level.

There are numerous influencing factors within institutions; four factors are identified below as having direct impact on the success of the POHE programs: (i) university strategic vision and mission; (ii) the management structure system of the school; (iii) organizational culture; and (iv) the quality of the personnel resources of the school.

School vision and development strategies:

Six of the eight universities in Phase I viewed themselves as research oriented universities. The school's priorities for academic research can be a barrier (or at least not supporting) to the implementation of profession-oriented training programs. The problem is that, while institutions are said to be research oriented, they do not actually produce much research. However the relative weakness in research is not offset by gearing education toward the more immediate needs of the WoW. Surveys and understanding of the labor market are limited. Most schools do not have regular studies on the needs of the WoW. There is also a lack of participation with the WoW in their training process.

Management systems and regulatory processes of the school:

The POHE style requires several changes that are not consistent with current regulations. The decision-making mechanism of Vietnamese universities on academic issues is dependent on a scientific and academic committee which includes all members of the deans and heads of functional departments. This mechanism may not be favorable to the decisions needed for the changes that the POHE education requires, because the existing POHE programs are seen as very small compared with the entire school in terms of quantity. That is why in the majority of cases, the POHE programs have been implemented in a small corner of the university as to be seen as "projects," whether at the school or departmental level. This means that at the end of the project the POHE conducive structures that have been established can be completely changed or they stop to exist. The perspective that the "POHE is just an ending project" seriously undermines the sustainability of more professionally oriented education at institutes that view themselves as research oriented.

Professionally oriented education requests more work compared with traditional training approaches. These initiatives are unable to take place without financial support of the schools and incentives for faculty members. Vietnam universities adopt "University Financial Regulations" which are internal spending rules/principles/formulations applied for calculating payment for certain work. What factors should be taken into account for the lecturer payment formula that reflects the school priorities? Findings show that salaries are currently mainly based on teaching hours in addition to seniority and academic degrees/qualifications. Other forms of student interaction like coaching or internship supervision are underestimated in the current salary calculation methodology. The interactions with WoW efforts on improving teaching approaches were simply not counted and took place because of incentives provided by the POHE 1 project. The current financial regulations are obviously supporting faculty members in pursuing traditional, frontal teaching approaches. This complex and well established set of institute-specific regulations hamper the institute and individuals from investing in linkages with the labor market.

Organizational culture of the school

The traditional education style which focuses on rote learning and theoretical concentration, teacher-centered and lecturing rather than coaching, is still dominant. There is always resistance toward changes in education. Objections from those who do not understand a professionally oriented education philosophy or those having a different perspective or even those that do not want to give it a try are significant obstacles.

The POHE approach as piloted to-date is different from the traditional method of training in many aspects. Successful implementation of the POHE requires people who take risks and who are pioneers ready to accept the challenges and take the responsibility for making an innovation possible. This is not a culture we can easily find in most schools today in Vietnam.

In addition, the context in which universities operate is not very conducive to changes in the organizational culture at universities. Despite the changes that are slowly being made by a "top-down" instruction-based national governance system, its lingering effects are noticeable in the HEI. Initiative was never very much encouraged while towing the line was seen as an important attribute to make a career. People were assigned jobs rather than following an HR philosophy aimed at an individual's motivation to do a certain job. These characteristics in the current organizational culture of HEI result in considerable inertia to change, for instance, as proposed in the POHE project.

3.5 Recommendations at policy and institutional levels for all stakeholders

Vietnam is a top-down system in which, at the policy level, MOET plays a key role in creating a national framework supporting professionally oriented education. POHE Phase I was successful in terms of curriculum development and in improving educational quality within the project framework. For implementing the POHE system-wide, Vietnam will need to focus on systematic management issues and address problems and obstacles that came to light during Phase I.

University autonomy is a necessary condition for schools to deal with problems observed in Phase I. It should include full autonomy (i) regarding academic affairs: not to be restricted to the Legal Core Curriculum; to be forced to implement a credit system too rigid or a yearly system; (ii) regarding financial issues: to be allowed to generate revenue and using it as incentives for improving teaching quality and support of POHE activities; and (iii) regarding personnel issues: to set a criterion to select, promote or dismiss university staff when necessary. Since POHE is newly established as an innovative approach for training programs in Vietnam, there may be unsuitable or inappropriate government regulations which would hinder POHE implementation. Therefore, it is necessary to make room for schools that are large enough to find solutions on their own.

Vision of leadership is especially important at both the institutional and national level. If school leaders frame their POHE programs within the project funded by Dutch ODA support, then these programs will certainly end when the project is completed. However, when considering POHE as an opportunity for university innovation, a strategic institutional development for survival, a mission that is well-conformed and consistent with university aspirations, POHE could be multiplied on a large scale and be sustainable beyond the project. Some indications have been found among the universities that have used POHE to improve the attractiveness to potential students.

At the national level, policy-makers should see POHE as an investment for improving university capacity for serving social economic development. An important element is that this model is based on cooperation between the university and the WoW. This vision will impact on strategic priorities through certain policies that will enable or restrain POHE implementation.

Legal framework, policies and supporting mechanisms for POHE sustainable development: At the national and institutional level, leaders voiced support for the POHE approach in statements or resolution documents. However, this has currently not yet been articulated into particular policies such as on the conversion of teaching hours and workload, payment rates for curriculum development and updating and for internship guidance for university business relations development, etc. These policies will generate motivation and encourage the teaching staff to improve the quality of their performance. At a national level, a connection with the WoW is a vital factor for the POHE. Strengthening this linkage requires the support of a national legal framework such as, e.g., tax deductions for cooperation between businesses and universities in terms of research, internships, etc. A suitable legal and policy framework needs to be developed for the POHE to further expand.

4 The implications of the project for supporting university-industry interactions in Vietnam

The evaluation has shown that the success of the POHE programs is based on interactions with the WoW. Its distinction from traditional programs also indicates the isolation of Vietnamese universities from the business sector in general. Looking at eight types of collaborations between the university (Davey et al., 2011:10) and businesses, we can see from the collaboration in R&D, and the commercialization of R&D results, that the mobility of academics and students, entrepreneurship and governance are all underdeveloped. It should be noted that, in Vietnam, research contracts with enterprises comprises only 6.1% of the total projects and 28% of the research funding by universities (Fatsea, M, 2010:107). In 2005, revenue from research-related activities constituted just above one-half of a percent of public institution revenue (World Bank 2007:83). Collaborations in curriculum development and delivery are major initiatives of the POHE, because the POHE project was not allowed to follow the rigid core curriculum regulated by the Ministry of Education. Outside the POHE projects, such collaboration in developing the curriculum of degree programs are almost non-existant. Life-long learning is currently the most common type of university interaction with the WoW in terms of the quantity of students enrolled in so-called in-service programs. However, unfortunately, many people take in-service programs for obtaining degrees which have, in general, a strong academic orientation. Therefore in-service programs as a form of life-long learning can hardly be seen as a successful case of collaboration between university and industry.

What is the logic behind the current situation? Vietnam's economy is still not very strongly knowledge-driven. Most domestic enterprises in Vietnam do not have a need for investment in research. This has a lot to do with the fact that the economic success of Vietnam is linked to joining the globalized economy with labor intensive products based on low-cost labor. Studies (World Bank 2011:9) show that very limited investment has been made in technology innovation as a way for Vietnamese companies to compete on the international and home markets. Another major role in their economic development has been played by companies established with Foreign Direct Investment

(FDI). Many of these companies are established to build on the human and physical infrastructure developed by many provincial governments.

If we look at the academic side of the UBC relationship we see a low capacity to perform research in addition to the fact that quality and relevance of research are also challenged. The WoW has poor motivation and had little responsibility for participating in the training process in the schools. The new Higher Education Law now stipulates the responsibilities of the WoW in training activities. However, regulations and guidelines, specific action programs or incentive mechanisms are not in place. The WoW is still involved in the training process only on a "voluntary" basis, and personal networking connections. Without specific incentives, industry does not have a strong motivation to participate in the training process of the schools. The question should be asked if a strong reliance on regulation will result in better collaboration from the WoW side. It is the UBC unfamiliarity with the WoW and a limited understanding of what benefits companies could have from working closer with universities in keeping education up to date and in conducting joint research. From the side of academia, limited experience with the UBC is strongly grounded in the low level of university autonomy in terms of curriculum design. It is also hampered by the broader governance structures that emphasize top down pillar-like structures rather than localized, horizontal structures based on the needs of individual organizations

With the new higher education law, the position of the universities will change and the basic conditions are in place for the emergence of a localized, more organically growing ecosystem which breaks with the planning and regulation traditions now in place.

This process is already underway to some extent as some positive examples of university and business cooperation in Vietnam can be found. Join research activities, contract research, support of innovations applications, commercialization, etc. are Ho Chi Minh City University of Technology practices which is well-known for its close relationships with domestic and foreign-owned enterprises. Another famous example in Vietnam is the FPT University, which belongs to FPT (The Financing and Promoting Technology) Corporation. This enterprise works on information and communication technology and is comprised of 83 sub-companies. FPT’s academic off-spring is a new model of training institutions which focus on training future staff in ICT. The FPT University was built to better meet the human resource needs for the development of the company as it found that traditional institutions focus their training too much on purely theoretical knowledge and graduates lack relevant skills and experiences needed by the FPT companies.

However, FPT University is a quite unique case among Vietnamese universities in terms of its origins. It is structured using the traditional patterns but rather than a ministry responsible for a specific economic realm it is now a huge semi-private company that builds vertical structures to ensure its HR supply. This seems a logical approach in a system that has many vertical structures as part of its centralized planning system. The more so, current state structures include little incentives to develop more horizontal organic relationships with existing universities.

A more important issue would be what makes the relationship between university and industry work more effectively in specific contexts and a socio-economic development situation in Vietnam? In other words, how could we create an ecosystem (Davey 2011) for UBC? At an action level, what strategies, structures and approaches, activities, and framework condition each stakeholder (university, business, government) need to be taken? At a factor level, what are the benefits, drivers, barriers and situational factors that encourage or hinder the development of UBC in Vietnam? At a result level, how did cooperation result in collaboration in R&D, academic mobility, student mobility, commercialization of R&D results, develop lifelong learning, promoting entrepreneurship, and participating in institutional governance? What types of collaborations are more feasible and most useful in current situations?

These questions call for more studies because POHE I as a pilot program does not provide enough data for a systematic analysis. However, its achievements imply some interesting suggestions for higher education reform in Vietnam. Only now in Phase II of the project some linkage to national policy is being established by MOET. However no clear policy statement has been made at this point on the role the POHE will play in a multi-tiered system. POHE is seen as a source of information to institutional systems and approaches on how to help universities to successfully build better understanding of the reality of business and organizations. POHE I has demonstrated huge benefits by WoW engagement to education. From the POHE project implemented within eight universities to implanting these experiences to the HE system as a whole still has a long way to go. The successful transplanting of the POHE experience will require a strong and well articulated vision on the issue and a defined strategy, at both national and institutional levels.

5 Discussion

The Vietnamese higher education sector is in flux. One of the most notable changes is the drive to have universities operate as more autonomous institutes. This important sector-wide change is further supported with the ideas to define different types of universities and redefine the mission of the ministry of education and training more into one with a supervising role at the sector level. This will be a broad transformation in system and institutional organization and management where universities gain more responsibilities for the development and delivery of education. Until recently, all curricula were centrally developed and enforced. Piece-meal actions were taken that supported the shift to a more autonomous HEI captured in a new law on higher education that came into effect in early 2013. The effectiveness of the law is currently limited as much of the decrees and regulations still need to be developed and promulgated.

The introduction of universities with more autonomy poses opportunities but also challenges for UBC activities at universities in Vietnam. Management at the university and department level will be able to steer education and research activities much more on the basis of their own agenda. However the opportunity to synchronize education and research more with societal needs through UBC remains a challenge for several reasons.

The large challenge is that few universities have real experience with an institutionalized UBC systems and activities. The POHE I and II projects find that developing effective UBC activities is complicated by the fact that strategic vision and mission at the institutional level has never really been articulated. The centralized approach which is a strong characteristic of the HE in Vietnam resulted in the conditioning of university management to see themselves as implementers of general centrally issued policies.

The project has found that conditioning of university staff by the system has led to numerous “ghost” regulations. By this we mean that at different layers within university management a firm conviction exists that certain central policies, particular in regard to curriculum development are still in place. This has led to considerable frustration at the central level where concerted efforts have been made over the last years to devise new central policies to make universities more responsive in their educational development. An articulated call from the ministerial level to the universities to develop UBC has as yet never been issued. But the space to use UBC to develop new curricula policy has been there for some time. The experience of POHE I was that most universities regarded the collaboration with the WoW as a tenant of the project rather than a way in which a technique could be used to improve the responsiveness of education. The new law on higher education could give a new impulse to UBC as it better articulates the responsibility of the universities.

The confusion about what policy is in place is a partial explanation as to why the push for reform has shown mixed outcomes. A far more important change to the university landscape in the last decade has been the break-neck pace at which higher education has expanded in terms of student numbers. To make this expansion happen, much needed to be changed in curriculum development or other policies related to improving the quality and relevance of education. More investments in facilities were made and importantly there was a shift in the financing of public higher education where currently about 45% (World Bank 2013:12) of university income is dependent on tuition. The emerging affluence among the population has been used for HE expansion. This expansion banked also on the strong belief in Vietnamese culture that education is the main avenue for social mobility. The reliance on tuition fees has raised concerns about equitable access to higher education as scholarship-based funding has not kept pace with these developments, World Bank (2013:57) But another effect which has been noted in both POHE I and II is that universities have been becoming more entrepreneurial in which attracting more students has been a very important way to increase income.

It seems that income orientation in combination with management practice to implement central policies has, until now, not been a fertile feeding ground to institutional specific UBC plans and strategies. Internal and external drivers and benefits have been missing. The reason for the lack of drivers can also be found in the way the higher education sector and the state organization in general has been structured in Vietnam. It is related to the ideological tradition with strong top-down structures allowing the state to govern society on the basis of the vision of the party. With the introduction of market-based reform some changes have come about, however, economic and state sectors are generally headed by a ministry which oversees its own universities, companies and structures in dealing with its responsibilities. This system in Vietnam is seen by a number of observers as an important part of the success in developing in a relatively equitable manner. However the “stove pipe” structures are highly conducive to implementing central top-down policies, however, they are inhibiting more organic horizontal collaborations; Vietnam has an ecosystem in which UBC could be developed. But it is difficult to start becoming part of the soci-economic ecosystem for public universities as their organizational perspective, culture and regulatory policies stem from the larger state organization system and approach.

These larger structures on which the state organization rests are one of the most inhibiting forces to UBC. To deal with the vertical system, structural reforms of the state organization would be needed. For this to happen appears very unlikely as they underpin the core philosophy of the state and are engrained in everyday culture of the people and organizations. Still in the largely liberalized privately owned sector of the economy, organic relationships are emerging between companies. However the manner in which companies interact with state bodies is often motivated by the need to obtain access to resources or to gain specific permission needed for companies to operate. In this process the mixing of private and public interest is quite common. Public universities are seen as strongly state-related and UBC initiatives undertaken by the HEI is often viewed by business with the paradigm on how the private sector deals with state bodies in general.

However the POHE I project has shown encouraging signs that after considerable effort UBC relations have been developed in the framework of curriculum (re)development and internships. Some companies have started to understand their interest in UBC. However the general experience at universities participating in the project is that maintaining the relationship with the WoW is difficult. At almost each university, the call was heard to institutionalize its UBC relationship within the existing stop-down structures. The suggestion was that there should be a law or regulation requiring companies to hire interns and work with universities. There is still considerable preference to rely on the state structure to define relationships between the WoW and HEI rather than to seek common interest as a motivator for UBC. The strongest expression of the belief in a top-down organization of the state and society is that several very successful companies have set up their own universities. In the IT and gas and oil exploitation sector and in tourism it was easier for companies to create their own institutes then to engage with existing universities to improve employability of new graduates in these sectors. The replication of established patterns has a multitude of reasons that cannot be explored here.

This re-establishment of old structures is on the one hand an expression of the difficulty to fully understand the benefits to be gained by both parties in UBC. But, on the other hand it also reflects the current framework of conditions made up by the strongly articulated vertical structures in state bodies and consequently in society. Furthermore the vision on developing the university held by management is tainted by the habit of waiting for central instruction rather than to look into the immediate surroundings. These habits and the organizational culture aspect of the HEI sector in Vietnam is perhaps the most difficult to renew. The POHE project may be used to demonstrate the benefits of UBC development. Of importance, however, is making sure that universities develop these business relationships within the context of Vietnam. This is not easy because economic and societal developments take place at a very high pace.

6 Conclusions

There is a need to increase the number of students who are well prepared to perform in their future jobs. POHE is a practical approach in order to meet the goal of 70-80% of HEIs focused on the direction of profession oriented versus 20% focused on research orientation within the Higher Education system. The achievement of the project can be a source of inspiration and provides valuable information and experiences for HE reforms. It also calls for further studies on the specific context of Vietnam that will serve policy development so that a legal framework can support a self-contained ecosystem of UBC that does not need top-down instructions for it to work. The project took place at the right time when new Laws on HE take effect – higher level of university autonomy is given; and multi-tiered HE system is implemented – professionally oriented education approach is helpful for the majority of HEIs. Although the POHE project has involved only a small number of participating universities and accounted for only a small number of students compared with the whole system, its implications for reforming HE system towards UBC improvement are significant and should be taken advantage of.

The emergence of organic relationships with the WoW that are an expression of a high degree of embedment of universities in society will rely on more space given to universities. This space is currently clearly emerging with the drive to create more autonomous universities. However, overcoming the inertia to change will depend on organizational culture change. How to foster this change is a more difficult question. It is beyond remitting the POHE project to provide subsidies to companies to engage in active collaboration with business. But Vietnam will be able to gain from international experience in these types of subsidy programs to provide effective incentives for UBC development.

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[i] http://www.svvn.vn/vn/news/doisong/4121.svvn

[ii] http://ash.harvard.edu/extension/ash/docs/Apex.pdf

[iii] The National Strategy for Socio-economic Development 2011 - 2020 defined "development of human resources, especially high-quality human resources is a breakthrough of higher education by 2020". The Higher Education Human Resources Development Strategy period 2011 - 2020 approved by The Prime Minister that has set the orientation on the basis of training according to the needs of social development, focused on the linkage between supply and demand for human resources

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Determinants And Barriers In The Development Of The Entrepreneurial Orientation In The Polish Higher Education Institutions

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Abstract
The main aim of the paper is to present the results of the research project on the entrepreneurship in the Polish higher education institutions. The project was funded by the Polish National Science Centre and its main aim was to identify the factors that enable, enhance, limit or disable the entrepreneurial potential in higher education institutions. The paper gives an overview of the identified determinants that foster the entrepreneurial orientation in the Polish universities. It also points the key internal and external barriers of that process. The results are presented in the context of the management theory on the one hand and on the other with the theory of higher education, which sometimes are quite contradictory and confusing.

Keywords
Entrepreneurial orientation, Entrepreneurial university, Innovativeness, Proactiveness.

1 Introduction

Analysis of the present functioning of Polish higher education institutions (HEIs) shows that the competition factor is playing an increasingly important role on both the strategic and operational level. The need to compete applies to all universities, regardless of their ownership status – public or private. Competition between the institutions can be observed in nearly every sphere of their activities, whether related to teaching, research or implementation. In all organisations, both commercial enterprises and public benefit institutions, such as universities, competition determines the phenomenon of entrepreneurship, defined by Peter Drucker (2007) as the source of competitive advantage on the market.

The phenomenon of entrepreneurship, i.e. the ability to create innovation, shows in every aspect of operation of an organisation. In the case of two businesses competing on the market, entrepreneurship is manifested as the organisation’s ability to satisfy its customers’ needs better than its rivals, and consequently, achieve the dominant position on the market. The specificity of the sector of science and higher education is fact that the term of market, customers of competition can be defined variously. However regardless the starting point or assumed perspective, almost every higher education (Clark, 1998) institution needs to compete – for students, resources or public trust. Therefore they have to evince the entrepreneurial features.

2 Polish Higher Education System

Since the beginning of 90's the higher education sector in Poland has been changing in a very dynamic and often chaotic way. The political changes that took place in Poland in the early 90's of the twentieth century, created the opportunity for the private institutions to enter the market. The first private higher education institution have been operating since 1990. Open market caused the rapid growth of both supply (figure 1.) and demand (figure 2) for higher education.

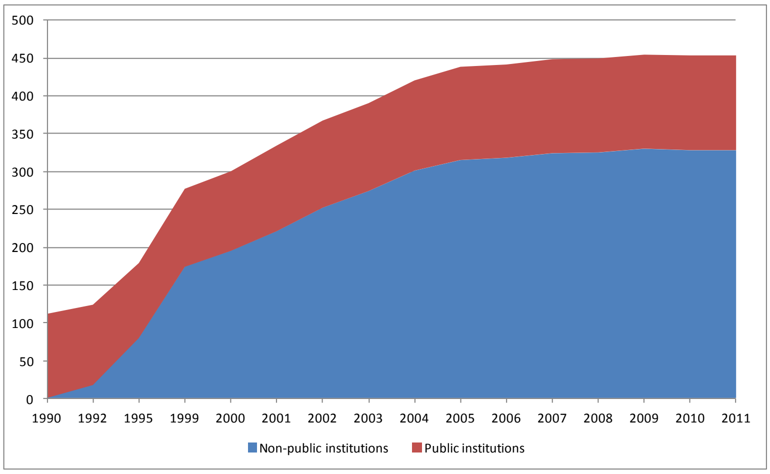

Figure 1. The number of HEIs in Poland in 1990 – 2011

Source: Central Statistical Office www.stat.gov.pl;

The rapid growth of the number of higher education institutions, has created the possibility of broad access to higher education. It resulted in an extremely dynamic growth in the number of students. However, the increase in the number of students was also caused by growth in the demographic trend - young people aged above 19 years old. However, favorable demographic has already passed, which is also noticeable in the total number of students at Polish HEIs. Demographic factors are so important for the functioning of Polish higher education institutions, since their income from teaching activities is 77% of public and 86.4% of non-public institutions' operating income in total.

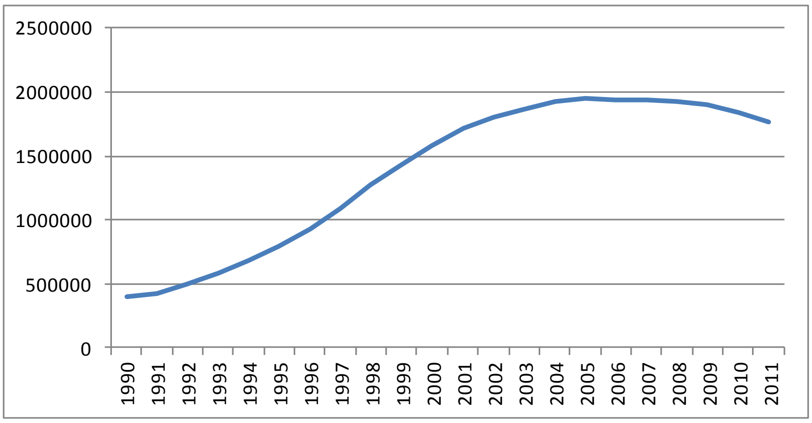

Figure 2. Total number of students in Poland in 1990 – 2006
Source: Central Statistical Office www.stat.gov.pl;

According to forecasts, this favorable demographic trend, has reversed, resulting in a number of potential candidates for full-time programmes will decrease for at least next 15 years (figure 3.)

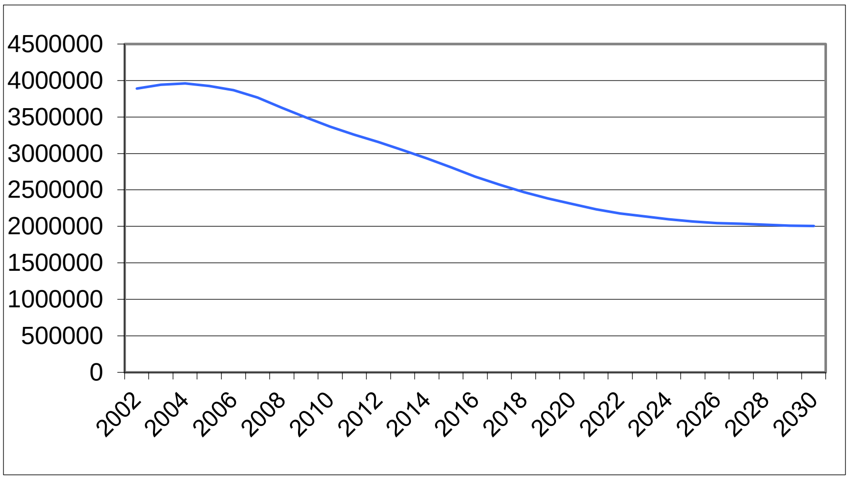

Figure 3. Prognosis of the total number of people of 19-24 years old in Poland in 2002 – 2030
Source: Central Statistical Office www.stat.gov.pl;

Unfavorable demographic situation, combined with the increased and growing supply of educational offer, has led to increased competition between different actors operating on the market. As a result of these factors in quite natural way the phenomena of liquidation, acquisition or merger of higher education institutions have been noticed. Only in 2013, there are 24 non-public higher education institutions in the liquidation process, out of 328 total functioning. The consequences of turbulence in the environment are also visible in public HEIs, yet financially stable. The best proof of the inevitability of this process is the development by the Ministry of Science and Higher Education the special regulations in the event of financial problems of public higher education institutions, including the conditions of receivership of a institution in order to save it from bankruptcy.

The natural conclusion of observation of these changes was to undertake research on the entrepreneurial behavior of the Polish higher education institutions.

3 Research Subject

The main problem of the research project was based on current knowledge of the entrepreneurship phenomenon in general and in universities in particular. The existing gap in the literature that would include the Polish context of the subject was also identified. The main aim was to define the role, relevance and feasibility of the entrepreneurial potential of Polish universities to build their competitive advantage. Among others the main objectives of the study was: to identify the internal and external factors affecting the development of entrepreneurship in Polish universities; identify opportunities to use the entrepreneurial potential to achieve competitive advantage.

The research aimed to identify the entrepreneurial activities of Polish universities in several areas of their operation: the organizational structure, the autonomy of individual organizational units, strategic management, human resources management, risk management and competitive behaviors. The outcomes allowed determining the level of the individual institution's qualities characteristic of entrepreneurial organizations.

The first group of the qualities describes the entrepreneurial orientation of the institution. Researchers point to five key dimensions of entrepreneurial orientation (Lumpkin, et.al. 1996) i.e. autonomy, innovativeness, risk-taking, proactiveness and competitive aggressiveness. It is also noted that all of these factors do not necessarily need to occur simultaneously. They can also occur in varying intensity, depending on the nature of the environment and organizational culture the institution. Entrepreneurial orientation is important for maintaining the dynamic development. This is especially needed in large institutions, which tend to stabilize their organizational structures and decision-making processes. In consequence they can reduce their mobility and ability to make quick decisions, which is key to maintaining a competitive advantage (Frank et.al., 2010)

Another group of the characteristics of an entrepreneurial organization, are factors affecting the entrepreneurial potential of the institution. It has been specified in the Intrapreneurship Assessment Instrument (Kuratko, Montango, Hornsby, 1990). The einterpreneurial potential composes of three main organizational features: Management support for intrapreneurship, organizational structure, reward and research avaiability. These qualities enable in particular big organizations to foster internal entrepreneurship (Kuratko, et.al., 1993).

The third researched dimension was a general entrepreneurial mindset. It is seen as a prerequisite of entrepreneurial orientation. It is also necessary for full usage of entrepreneurial potential of the institution. According to the *entrepreneurial spirals* concept (Shepherd, et.al, 2010) the level of entrepreneurship of an organization is directly related to the entrepreneurial mindset of its manager. Within this issue the awareness of the institutions to undertake the entrepreneurial actions was studied. Such actions are directly related with pursuing new or perpetuating existing competitive advantages of the higher education institution

4 Methodology

The conducted pilot study showed that the best method of research would be a qualitative moderated interview using the Individual in-Depth Interview (IDI) technique. It is one of the most popular qualitative research methods. Its main aim is to gain as much specific information as possible. IDI is

IDI is an individual, thorough discussion of the moderator and interviewee. Individual interviews are pre-determined by the range of topics covered. Conducted by a moderator qualitative interviews in a form of free discussion with the use of topic guide allow to obtain in depth knowledge of the researched issues. In this case, the scenario of the interview involved a relatively detailed range of open-ended questions. The order and form of the questions was matched by the moderator to the individual style of the interviewee. The research covered the following groups of respondents: rectors, vice-rectors and chancellors of Polish higher education institutions.

The survey used quota sampling of test sample, in relation to the structure of the population (i.e. type of studies, number of programmes, type of institution, etc.). Assumed the sample size of 45 institutions, representing about 10% of the total population. This sample size enabled the realization of research in the form of in-depth interviews directly with the top management of the higher education institutions throughout the country. Education sector has been divided into nine groups as homogeneous as possible (i.e. universities, technical universities, non-public academic institutions, public schools of higher vocational education, etc.). The ranking of HEIs each group was prepared. It was based on publicly available data concerning all the institutions in each group. The data concerned i.e. the scientific quality of the institutions, number of students, number of offered programmes, etc. It was assumed that within each group, the data may reflect the results of each institution's actions in terms of their innovation and competitive advantage.

The final choice of the interviewed institutions was made by the purposive sampling: 2 top, 2 bottom and 1 institution of the middle position in the ranging within each group. This selection provides a good representative of the population while maintaining its structure, in the context of the purpose and scope of the audit. The selection also included geographical distribution of the chosen institutions.

5 Analysis

Each of the entrepreneurial characteristics taken into account in the study was operationalized for the analysis of the interviews. The intensity of each of the features defined in the five-point scale. In the table below are exemplary descriptions of entrepreneurial qualities:

Quality	Scale				
	1	2	3	4	5
Innovativeness (support for new ideas, creativity, leading into improvement in the use of resources)	Avoiding innovations; lack of support for innovations	Fake innovations i.e. changing the name without changing the content	Seeking for the safest possible option	*Creative imitation*	Constant search for new ways of development
Effective reward system	Equal salaries	Typical, rutine awards system	Individual one-time awards supporting single initiatives;	Non-complex reward system i.e. oriented mainly on one type of initiatives	Fully flexible, individualized evaluation and reward system

Table 1. Exemplary descriptions of entrepreneurial qualities

6 Findings

The results can be divided into two general categories. The first concerns the overall conclusions concerning the management techniques used in Polish higher education institutions.

The hierarchical structure of public universities, whose key element is the performance of control function by lower-level units with respect to higher-level units results in a longer decision-making process. In many cases, before a matter is resolved, it has to be reviewed at each level of the hierarchy, which contributes to the expansion of bureaucratic procedures. Meanwhile, in the respondents' opinion, the chief advantage of the management structure at private universities is the optimisation of administration costs. On the other hand, because of the centralisation of authority, most decisions are in the hands of the rector, who often does not have adequate managerial skills and makes the decision based on his or her convictions. What is more, especially in the case of small private institutions, it leads to the extreme lack of independence of other members of staff, who leave even the smallest matters in the hands of the rector, e.g. the decision concerning the location of an announcement board.

The findings of the study show that the strategy of an institution, regardless of its type, was often developed following an order from above. Very few respondents from private institutions stated that the strategy was created independently from the Ministry requirements, but in response to internal needs. In the cases investigated the development of a strategy was not often based on specific analytical methods. Generally, the data obtained from the interviews suggest that the analyses performed did not have the characteristics of systematic, planned measures and in some cases of the smallest private schools they were based on the key staff's general knowledge of the world and region. Many respondents did not perceive the strategy as a document supporting the functioning of the school and useful for all staff and defined it as a hybrid of mission, vision, tactics and forecast. The strategy was seen as a framework document, loosely related to the actual operation of the university and defining the directions of development in a very general way.

In the context of the material analysed, the respondents understanding of risk and hazardous situations in the school management turned out to be significant. Analysis of the statements given by the respondents shows that both in the case of public and private schools the persons surveyed did not have a deep awareness of risk, sometimes admitting that they are unfamiliar with any risk management methods. Interestingly, the respondents did not mention any methods involving a systematic observation and analysis of trends in Polish, European or global labour markets or specific, structured and long-term plans of cooperation with external entities apart from very general visions of developing informal cooperation networks with the environment defined in various ways (on the regional, national or European scale). At the same time representatives of universities of technology more frequently perceived the risk involved in implementing projects for external entities, due to financial penalties for a breach of contract. On the other hand, the respondents from non-technical universities pointed out the risk arising from the absence of non-statutory control mechanisms regarding the professional development of the academic staff and the resulting cases of unexpected loss of rank, prestige or importance of certain faculties. However, they did not mention any preventive measures that might provide an effective remedy for the risk defined in this way which, as shown in the above example, was often perceived as a threat. In one case only, the respondent equated the risk not only with uncertainty and threat, but also an opportunity to succeed.

The methods of staff motivation implemented by the schools surveyed do not have the character of systematic or consistent measures. Some respondents, both form public and private universities, pointed out that it is not necessary to activate academic workers additionally, since they engage in research based on their internal, personal motivation. Generally, in many of the universities investigated and regardless of their type, there is a firmly rooted conviction that academic development is an individual matter, determined by internal motivation. Consequently, the issues of motivating, supporting, planning and accounting for research work are underestimated and in most cases reduced to procedures imposed by the law. There are no internal systems taking account of the staff's needs or diversifying the types of support depending on whether they apply to individuals or teams.

Although higher education institutions have considerable autonomy in the development of their educational offer, which in theory enables the tailoring of the offer to the needs of the economy and making full use of their potential, in many cases it leads to the curricula being frozen and dependent on the current teaching staff resources of the schools.

Additionally, the respondents, regardless of the type of school, were hardly ever able to indicate other schools or categories of schools that would constitute direct competition of their own activity. The simplest typology was often used: universities pointed to other universities, private schools to other private schools offering similar courses and vocational schools – to vocational schools. Some respondents claimed that their institutions do not have any competition (e.g. because of low fees, highly specialised courses or the size or tradition of the schools, ensuring its dominant position).

The second category of the conclusions are the results at the level of individual groups of higher education institutions. At this level of analysis, there are clearly recognizable individual cases that distinguish themselves upon the rather pessimistic background. The research outcomes clearly show that the institutions located on the top of the ranking in their group, exhibit distinct entrepreneurial features.

In most cases, the top-ranked institution managers have clear vision and development policy. They are proficient in the strategy management and identify the benefits from the active, supportive human resources management. Finally they seek the competitive advantages and encourage others to do likewise.

Figure 4 illustrates the differences in the observed levels of the entrepreneurial orientation qualities between the institution from the top and the bottom of the group of the non-public academic institutions.

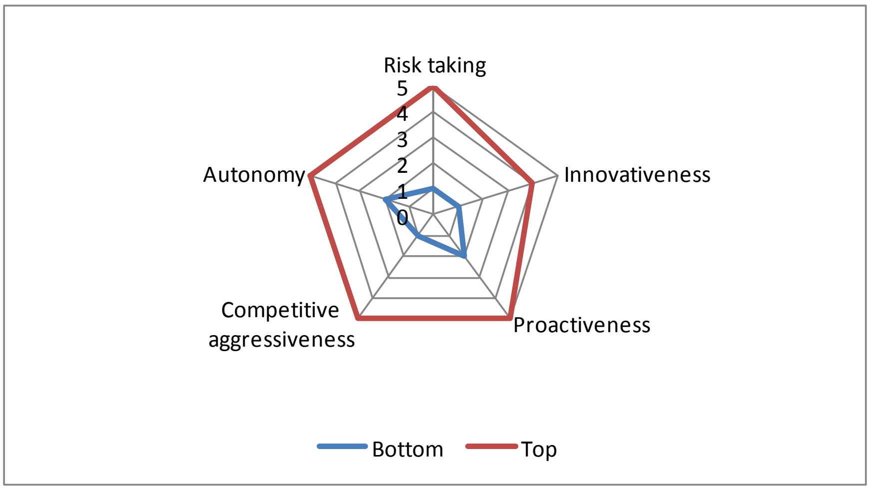

Figure 4. Level of entrepreneurial orientation in two HEIs from the non-academic public institutions

Although the qualitative data are not as accurate as quantitative the difference between the institutions is clearly visible. The general conclusion from the conducted analysis is the more entrepreneurial the higher education institution is the better it deals with the competitive environment.

7 Conclusions

The interview scenario also included the questions about the barriers in the development of the higher education institution. The circumstances perceived as the greatest obstacles to the development of universities, especially with respect to small private institutions, were external factors, such as excessive interference of the Ministry and the excessive amount of detail in regulations concerning education. Representatives of other private schools stated that one of the main barriers to development is the imposed unfair redistribution of funds for university education, blocking the possibility of healthy competition with public universities. In their opinion, public universities enjoy a privileged position, and the selective state support allows them not only to develop research programmes, but also the infrastructure, resulting in a situation where function beside each other, having similar conditions to fulfil but entirely different starting positions.

Regulations were also named as the greatest obstacle to the development of public universities. According to the respondents, the public procurement procedure is ineffective, difficult and has a negative effect on research work. The education policy of the government is also a significant barrier, especially the inadequate funds for supporting higher education.

The most significant fact is that very little interviewee referred to any internal factor as a barrier. Nevertheless the research revealed a huge gap in the managerial skills of the rectors that would allow them to successfully introduce the entrepreneurial orientation in the higher education institutions.

Summarizing, there are quite obvious external barriers of development of the Polish higher education institutions: the level of legal regulations, bureaucracy and demography. Nevertheless they are not the key barriers in fostering the entrepreneurship in HEIs. These would definitely be internal, as the research seems to prove. Among all the most important would be: low level of the general strategic management and human resources management in the institutions.

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Models Of University-Industry Knowledge Transfer And Their Implications For The Choice Of Performance Indicators: The HE-BCI Survey Case

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Abstract
This paper highlighted several competing views and characteristics of “what is” academic knowledge, and to what extent these models impact the measurement of universities’ knowledge transfer performance. We argue that the disconnection between, on the one hand, the need to provide a comprehensive and accurate representation of universities’ knowledge transfer activities, and, on the other hand, the rather narrow view of knowledge transfer which appears to underpin the policymakers’ choice of indicators, as an important source of problems in the identification of suitable indicators of knowledge transfer performance. We first identify the problem theoretically through three different models of knowledge transfer, corresponding to two main ways of conceptualizing the nature of knowledge and its properties. By focusing on the case of the HE-BCI survey in the United Kingdom, we show that the choice of indicators in this survey is informed by a rather narrow view of the knowledge transfer process, and that this in turn generates several shortcomings with respect to the ability of universities to accurately represent their knowledge transfer activities. We present some data illustrating these arguments – in particular, we show that the chosen indicators are better suited to measuring the knowledge transfer activities of some universities, rather than being appropriate across the board; and that the ranking of universities in terms of performance is very sensitive to the way in which the indicators are constructed. In the conclusion, we sketch some possible directions that could explored in order to identify indicators, and ways of aggregating them, that would overcome these problems.

Keywords
Knowledge transfer, performance indicators, university-industry relationships, HE-BCI survey.

1 Introduction

One of the most widely shared views in current economic thinking is that the creation and dissemination of new knowledge underpinning innovation is an important driver of economic growth. As a key producer of new knowledge in the economy, the university’s role in supporting regional and national economic growth and development is increasingly acknowledged: universities are no longer seen as “ivory towers”, producing knowledge in isolation, but as economic agents engaging with a multiplicity of stakeholders in order to deliver economic benefits.

Consequently, while in the past government intervention with respect to the university was limited to the provision of funding for the production of new knowledge and the training of human capital, current governments increasingly devise ways to ensure that the knowledge that universities produce is transferred to economic agents who can exploit it productively. In many countries, these interventions are carried out in the context of evidence-based policy approaches that aim to bypass ideological stances and ground policies in sound empirical evidence.

The focus on evidence implies that the monitoring and assessment of universities' knowledge transfer performance must be an integral part of policymaking, since monitoring allows policymakers to assess if and where interventions are needed and to design appropriate incentives. In some contexts, like in the United Kingdom, indicators of knowledge transfer performance are used to allocate funds to universities, this way impacting directly upon the universities' financial prospects. Even when indicators are not associated with the allocation of funds, they are recognized to play a performative role (Davis et al., 2010; Merry, 2011): that is, they signal what activities are considered important by policymakers, and which performance may be associated to implicit rewards (such as better reputation and standing in the eyes of policymakers, funding agencies and the public). Whether the rewards deriving from good knowledge transfer performance are direct and monetary, or implicit and non-monetary, the choice of indicators signals to universities how policymakers and funding agencies think they should behave and hence has the potential to actually influence their behaviour.

Because of their wide-ranging effects, policymakers need to carefully consider their choice of indicators. In this paper, we discuss what we consider to be an important source of problems in the identification of suitable indicators of knowledge transfer performance: the disconnection between, on the one hand, the need to provide a comprehensive and accurate representation of universities' knowledge transfer activities, and, on the other hand, the rather narrow view of knowledge transfer which appears to underpin the policymakers' choice of indicators.

We discuss this problem in two steps. First, we consider the problem theoretically. In section 2, we argue that there are several competing views of "what is" academic knowledge and what are its main characteristics, which are associated to different models of how knowledge transfer takes place and how it impacts the economy; and that each of these views carries different implications in terms of how to best measure knowledge transfer performance. We then discuss how this theoretical framework relates to the choice of appropriate indicators.

Second, in order to illustrate a specific application of this choice, we consider a specific case study: the set of indicators used to measure the knowledge transfer performance of universities in the United Kingdom. In section 3, we show that the current choice of indicators is not sufficiently comprehensive and that, as some of the chosen indicators are better suited to measuring certain forms of knowledge transfer than others, this may lead to a misrepresentation of the actual knowledge transfer performance of some institutions. These findings allow us to derive some suggestions for policymakers who are considering implementing systems of measurement of universities' knowledge transfer performance.

2 Models of knowledge transfer and their implications for the choice of performance indicators

The economic studies of the nature and properties of knowledge have highlighted that different views of knowledge are possible, each of which is associated to a specific model of how the production and transfer of knowledge should optimally take place. In particular, we argue that it is possible to identify at least three different models of knowledge transfer, corresponding to two main ways of conceptualizing the nature of knowledge and its properties. These different models of knowledge transfer have emerged over time in line with changes in the prevalent interpretation of the nature of knowledge as an economic good; each new model has not replaced the others, but all models have remained relevant and are now co-existing. They provide different rationales for different types of policies in support of knowledge production and transfer, as well as for the measurement of different knowledge transfer activities and for the use of different performance indicators.

2.1 Knowledge as information

The first studies on the nature of knowledge as an economic good dated back to the 1950s. In this period, the prevailing epistemological approach conceptualized knowledge as information, that is, knowledge was seen as perfectly codified and therefore perfectly transferrable from one person to another. The idea that knowledge could be "packaged" into bits of information, which could easily be transferred via a physical medium, and easily measured, was consistent with the linear view of innovation that was prevalent at the time.[i] The view of knowledge as information is associated to two different models of knowledge production and transfer. In both models, some form of public intervention is required to ensure that a sufficient amount of knowledge is produced in the economy. In fact, economic theory suggests that information has the nature of public good: differently from tangible goods, it is non rival, in the sense that its use on the part of one person does not prevent another person from using it at the same time; and, since it can be transferred rapidly and its marginal cost of reproduction is almost zero, it can be difficult to prevent anyone, including those who have not paid for it, from using it (Arrow, 1962). This gives rise to a market failure: as knowledge generates a positive externality in the economy, "the market" does not create sufficient incentives for private agents to produce the amount of knowledge that would be optimal for society.

The first model *(Model 1)* of knowledge production and transfer associated to the view of knowledge as information suggests that the market failure in knowledge production can be overcome thanks to the public funding of research and the open dissemination of the outputs that result from it. This model is consistent with the objective to maximize knowledge externalities, and with the idea that no support mechanism is needed in order to incentivize knowledge transfer: as knowledge is considered similar to information, economic agents are assumed to be perfectly able to understand it and implement it once it is placed in the public domain.

The second model *(Model 2)* associated to the "information view" of knowledge suggests that the market failure in knowledge production can be overcome thanks to the set up of a system of intellectual property rights. By allowing those who produce knowledge to have a monopoly on its commercial exploitation, knowledge is transformed into a quasi-private good for which efficient markets arise spontaneously (Dasgupta & David, 1994). The intellectual property rights system generates two types of incentives (Mazzoleni & Nelson, 1998; Andersen, 2004): the incentive to invest resources in knowledge production (by allowing those who produce knowledge to obtain an adequate economic reward for their efforts) and the incentive to transfer knowledge from one agent to another (by allowing knowledge to be commercialized, for example in the form of patents that can be sold or licensed). Since knowledge is assumed to be perfectly transparent, efficient markets should emerge as long as the government ensures the enforcement of clear rules for the protection of intellectual property (see Andersen & Rossi, 2012; Andersen et al., 2012, for a critique of these assumptions).

The view of knowledge as information therefore focuses on all knowledge transfer activities that involve the open dissemination of knowledge in a codified form (via publications, reports, books, blueprints, manuals, computer codes, presentations etc. - not necessarily free of charge) and the transfer of knowledge embedded in intellectual property rights (patents, copyright, trademarks, design rights). Because knowledge transfer is seen as a uni-directional linear process where the university provides a certain "output" to another party, then, according to this view, a good measurement of knowledge transfer performance involves quantifying that output – how much output is transferred, to how many users, what is its value.

Characteristic	Description of model
View of knowledge	Knowledge as information
View of process of knowledge production and transfer	Linear process
Appropriate way to support knowledge production on the part of universities	Public funding due to market failure in funding of knowledge production
Appropriate way to transfer knowledge on the part of universities	*(1)* Open dissemination of knowledge outputs or *(2)* assignment of intellectual property rights and trade in IPR markets
Appropriate indicators of knowledge transfer performance	Output-oriented indicators: amount, diffusion and value of outputs transferred
Theoretical references	Economics of information Linear model of innovation New institutional economics
Reference period	Since 1950

Table 1: Models 1 & 2: The view of knowledge as information and its implication for knowledge transfer

The key assumptions underpinning this approach are the following:

› information does not change in the course of the transfer process, hence the amount of information that is made available and the number of users who have accessed it are good measures of the amount of information that is actually received (this suggests that good metrics for universities' intensity of knowledge transfer would be, for example, the number of publications made, accessed and cited, the number of patents and other IPR filed, sold and licensed);

› the price at which knowledge is sold (or, in case of publicly funded knowledge, the price that the government pays in order to fund it) reflects its value to the user (e.g. the value of information is transparent), hence income from knowledge transfer is a good measure of its value to society.

2.2 Knowledge as an interactive process

Over time, a broader approach to knowledge has emerged, according to which knowledge includes all kinds of intangible goods, not only those that are codified and transmissible but also those that are tacit and difficult to transfer from one individual to another. This approach dates back to the mid-twentieth century (Ryle, 1949; Polanyi, 1966) but the debate has intensified since the 1990s thanks to the growing influence of the resource-based view of the firm and other heterodox approaches to firm theory in economics and management (see Cowan et al., 2000; Dosi et al., 2006, for comprehensive reviews of this debate).

This approach emphasizes that the transmission of knowledge requires practice and active participation on the part of those who receive it. To fully understand and apply a piece of knowledge, individuals and organizations may need the support of tacit knowledge gained though practice and/or of specialized knowledge, which is codified but potentially unknown to them (Cowan & Van der Paal, 2000). Therefore, knowledge transfer is facilitated by proximity, not just in terms of geographical distance, but also in cognitive, cultural, institutional and social terms (Boschma, 2005; Nooteboom, 2004). Moreover, it is increasingly acknowledged that new knowledge usually results from the original recombination of existing knowledge (Antonelli, 2005, 2006) and that the search for new solutions on the part of individuals and organizations is strongly driven by the knowledge that they already possess. The existing knowledge base is therefore both a driver and a constraint to the development of new knowledge (Lundvall, 1988; Nelson & Winter, 1982).

These features imply that knowledge is far less easily transferable than pure information, and that its public good properties are much less compelling. In fact, since the acquisition of knowledge requires time and often also direct interactions with those who possess it, it can be difficult for free riders to imitate it, even in the absence of intellectual property rights. The more knowledge is excludable, the greater are the incentives for its production on the part of private firms, as shown by much empirical evidence (Cohen et al., 2000; Levin et al., 1987; Mansfield, 1986). While this weakens the "market failure" rationale for public funding, other rationales emerge for the public support in the production and transfer of knowledge. In fact, even when markets create sufficient incentives to invest in knowledge production, the economic system may fail to provide sufficient opportunities or resources for agents to interact with other agents. In this case, appropriate interventions to support interactions may be needed to ensure that knowledge is diffused sufficiently in the economy; since those interactions in turn promote the recombination of existing knowledge, they are potentially able to stimulate the further production of new knowledge (that is, public intervention is justified on the basis of "system failure"; (Klein Woolthuis et al., 2005).

Characteristic	Description of model
View of knowledge	Knowledge as interactive process
View of process of knowledge production and transfer	Complex, systemic process
Appropriate way to support knowledge production on the part of universities	Public or private funding, or a combination thereof
Appropriate way to transfer knowledge on the part of universities	Implementation of mechanisms to foster interactions between universities and external agents ("system failure")
Appropriate indicators of knowledge transfer performance	Process-oriented indicators: Number, duration, intensity, characteristics and quality of interactions; learning on the part of both sides of the interaction
Theoretical references	Economics of knowledge Resource theory of the firm and other heterodox approaches to firm theory Non-linear models of innovation National systems of innovation
Reference period	Since 1990

Table 2. Model 3: The view of knowledge as an interactive process and its implication for knowledge transfer

The view of knowledge as a complex process resulting from interactions considers as relevant knowledge transfer activities all those situations where universities productively interact with external stakeholders. These may include, for example, the performance of joint research projects with industry, the provision of training and professional development, interactions around production and service activities (prototyping, testing, design, etc.), the exchange of personnel between university and industry and graduate placements. Because knowledge is actively constructed in the course of interactions, the measurement of knowledge transfer performance should not simply focus on the amount and value of outputs that are transferred, but also on the interaction processes themselves: that is, the frequency, characteristics and quality of the interactions and the (short and long term) learning processes that *both* participants in the interactions experience (i.e. with a focus on knowledge exchange rather than just knowledge transfer).

It must be observed that the distinction between these models may not be completely clear-cut. Different forms of knowledge may be closer to one or the other model, by different degrees. One the one hand, it has been acknowledged that the view of knowledge as information is particularly appropriate to describe basic research, which is far from any potential implementation. In this case, the market failure in knowledge production is particularly serious (Nelson, 1959) and in fact basic research is mostly publicly funded and its outcomes are disseminated openly through books, publications, presentations, talks, performances etc. (for example, much research produced in the humanities may fall within this description). On the other hand, forms of knowledge that are very specific to particular users generate very little externalities. Here we find that private organizations are willing to fund contract research, consultancies, the provision of various services, training and continuing professional development, graduate placements, and similar.

But there are also numerous intermediate scenarios. Sometimes the effective transfer of knowledge that is codified into a product (such as a book or even a patent) requires direct interactions with the researchers who produced it (Cohen et al., 2002); hence very often informal or even formal interactions develop around the use of published results or around the implementation of a patent licensed from the university[ii]. The creation of spinoff companies to exploit the IPR created by universities is another example of a situation where knowledge that is codified into a patent requires the setup of a system of stable interactions to implement it and commercialize it. In the opposite case, some services provided by the university are very standardized and involve no interactions where knowledge is produced (for example the rental of rooms and equipment).

2.3 Implications for the choice of indicators

The arguments put forth in the previous sections suggest that some indicators are better suited to measuring the transfer of certain forms of knowledge rather than others. Therefore, the choice of what indicators to use in order to assess universities' knowledge transfer performance may have important consequences for universities, since the use of a narrow range of indicators may advantage certain types of institutions (those which focus on the forms of knowledge and disciplines that are best measured by the chosen indicators) and disadvantage others.

This problem is particularly relevant in highly differentiated university systems, where universities focus on different areas of knowledge transfer to different degrees. The literature suggests that several characteristics of universities - such as their type (research-intensive universities, vs applied sciences universities), their geographic location, disciplines and objectives (Wright et al., 2008) as well as their knowledge transfer policies (Di Gregorio & Shane, 2003) - influence their knowledge transfer processes and performance. The system of assessment of universities' knowledge transfer performance should therefore avoid favouring certain universities and disadvantaging others simply because their profiles of knowledge transfer engagement are different. Instead, a fair and accurate system of assessment of universities' knowledge transfer performance should allow the transfer of different forms of knowledge to be represented and assessed comprehensively.

First, the range of knowledge transfer activities considered must be broad enough to reflect the variety of activities undertaken by universities: if the choice of activities to be measured is not comprehensive enough, the results may misrepresent the knowledge transfer performance of universities that engage in activities that are not measured. For example, universities that specialize in the arts and humanities usually do not produce patentable research outputs, so relying upon indicators heavily focused on the transfer of patents could disadvantage these universities.

Second, both output-oriented and process-oriented indicators should be included: the focus on output-oriented indicators may penalize universities that transfer knowledge whose social and economic impact is not accurately reflected by the measurable outputs or the income it generates. In particular, the assumption that the value of knowledge to those that receive it can be accurately captured by the income that the university accrues from it is debatable. For example:

- more prestigious institutions may be able to charge more for their services because of reputation, and not because of the value of the knowledge is greater;
- certain forms of knowledge are transferred for free or at a very low price because they are aimed at people who cannot pay for them – such as services to the community – but their value can be high from a social viewpoint;
- universities may choose to disseminate knowledge under open source licenses or other open mechanisms in order to achieve greater impact without receiving an income.

Third, indicators should allow comparability between different institutions, avoiding biases due to factors that do not relate to performance but to institutional characteristics such as size, disciplinary orientation, mission. For example, reliance on indicators based on the absolute amount of knowledge transfer activities, rather than on the amount of engagement in knowledge transfer per unit of staff, could disadvantage smaller universities.

Fourth, the system should be structured in such a way as to avoid the creation of perverse behavioural incentives. If the chosen indicators specifically reward only certain knowledge transfer activities, and not others, this creates implicit incentives for universities to engage only in the activities that are rewarded; but these activities may not necessarily be the most effective ways to transfer knowledge for all universities. For example, if the choice of indicators rewards universities that transfer knowledge via the sale of patents and licenses, this would incentivize universities to apply for more patents, even in cases when this is not beneficial.

In the next section, we illustrate, using data from the HE-BCI survey 2010/11, several ways in which the system implemented in the UK to assess and reward universities' knowledge transfer performance is likely to fall short on at least some of these criteria. We show how a narrow focus on what models of knowledge transfer are considered important and generative of impacts may influence the choice of indicators, leading to a selection of indicators that might not allow all institutions to accurately represent their engagement in knowledge transfer and the impact of their activities.

3 Case study: the HE-BCI survey in the uk

3.1 The UK's approach to the measurement of universities' knowledge transfer performance

In order to showcase the effect of the chosen view of knowledge transfer on the choice of indicators to assess universities' knowledge transfer performance, we examine the case of the United Kingdom. This case is interesting for several reasons. In the year 2000, the UK implemented a systematic survey aimed at capturing the exchange of knowledge between universities and industry (the Higher Education –Business and Community Interaction Survey, HE-BCI). Being one of the first countries in the world to have launched such a comprehensive exercise, the UK's choice of indicators of universities' knowledge transfer performance is likely to provide a benchmark for other countries in Europe and elsewhere.iii Therefore, understanding their rationales and drawbacks is relevant beyond the country's borders. Moreover, the UK has introduced measures that link universities' future funding for knowledge transfer to their current knowledge transfer performance, where the latter is assessed on the basis of some of the indicators collected through the above-mentioned HE-BCI survey. Hence, the choice of indicators to measure knowledge transfer performance has a direct impact on how many funds universities receive, and we can explore in some detail the implication of this choice. Finally, the availability of the HE-BCI survey allows us to support some of our arguments with detailed secondary data that are comparable across different institutions and over time, something that is rarely available for other countries.

The survey aims to capture the exchange of knowledge that takes place between higher education institutions (HEIs), the business community and society at large. As it was claimed in the HEFCE report (2012), this is indeed the main vehicle for measuring the intensity and direction of the interactions. Since its existence, the historical HE-BCI data has been used for reference towards grants allocations supporting knowledge exchange.[iv] The overall process is overseen by the HE-BCI Stakeholders Group (i.e.: UK higher education funding bodies; the Department for Business, Innovation and Skills (BIS); the Research Councils; and other representative bodies such as Universities UK, GuildHE and the Confederation of British Industry). The survey consists of two parts: Part A for strategic and infrastructural data and Part B for financial numeric data, which is time-bounded to a specific year.[v]

3.2 Models of knowledge transfer and choice of indicators

Table 3 summarises the areas and indicators measured in part B of the HE-BCI survey. Each of part B's five sections, listed in the first column, includes several key dimensions or sub-areas (listed in the second column). Several indicators are used in order to measure performance in each sub-area (listed in the third column). In the fourth column, we have mapped each sub-area included in the survey onto three possible models of knowledge transfer, described in section 2: (1) open dissemination, (2) transfer via trade of intellectual property rights and (3) transfer via interactions. We have also indicated whether the chosen indicators are oriented to measuring the outputs of knowledge transfer (consistent with a view of knowledge as information) or the process of knowledge transfer (consistent with a view of knowledge as an interactive process).

This mapping exercise suggests a number of remarks.

The choice of areas of knowledge transfer activity is very extensive but not exhaustive. Although it tries to capture all possible models of knowledge transfer between universities and external stakeholders, not all activities are investigated with the same degree of detail and some activities are overlooked.

The measurement of knowledge transfer via intellectual property rights (inspired by "model 2") is attributed high importance, as it includes 4 out of the 10 sub-areas measured in the survey, and 45% of all the indicators considered. This is despite evidence that shows that only few universities use this model with appreciable intensity and success (Litan et al., 2008), as it suitable to a limited number of scientific fields (Harabi, 1995; Brouwer & Kleinknecht, 1999). Moreover, the indicators are strongly biased towards patents and software licenses, further skewing the outcomes in favour of a few fields that produce patentable outputs, or software. Little attention is paid to other intellectual property rights (design rights, trademarks) and to many non-proprietary types of intellectual property that universities produce (materials and artefacts not protected by intellectual property, or protected by open source or creative common licenses such as open source software, blogs, wikis, open source film, open source media, open source pharmaceuticals, etc.) (see for example Andersen et al., (2012); Baghurst & Pollard, (2009)). As some types of disciplines (the arts and humanities, for example) are likely to generate the latter forms of intellectual property rather than patents, institutions that are relatively more focused on these disciplines may end up being unable to correctly represent the amount of knowledge transfer they engage in.

Sections	Sub-areas	Indicators used	Reference model of knowledge transfer / *types of indicators (output vs process)*
Research related activities	Collaborative research involving public funding[1]	Income, in–kind [2]contribution	Models 1 and 3 / *output oriented*
	Contract research[3]	Income, total value, number of contracts (by: SME[4] , Non SME commercial, non-commercial)	Model 3 / *output oriented with some process aspects*
Business and Community service	Consultancy contracts	Income, total value, number of contracts (by: SME , Non SME commercial, non-commercial)	Model 3 / *output oriented with some process aspects*
	Courses for business and the community (CPD and CE)[vi]	Revenue, total learner days delivered[5] (by: SME , Non SME commercial, non-commercial, individual)	Model 3 / *output oriented with some process aspects*
	Facilities and equipment related services	Income, total value, total number of services (by: SME , Non SME commercial, non-commercial, individual)	Model 3 / *output oriented with some process aspects*
Regeneration and development programs	Regeneration and development programs	Income from European Regional Development Fund (ERDF), European Social Foundation (ESF), UK Government regeneration funds, Regional Development Agency (RDA) programme, Others Income	Models 1 and 3 / *output oriented*
Intellectual Property (IP)	**Disclosures and patents filed by or on behalf of the HEI**	**Number of new patent applications filed in year** **Number of patents granted in year** **Cumulative patent portfolio**[6]	**Model 2 / *Output oriented***
	Licence numbers	Number of licenses for non-software and software (by: SME, non-SME commercial and non-commercial)	**Model 2 / *output oriented*** *with some process aspects*
	IP Income	Partner type: SMEs, Other (non-commercial) businesses and other non-commercial organisations). IP revenues, Total cost	**Model 2 / *Output oriented*** *with some process aspects*
	Spin-off activity	Spin-offs[7], staff start-up[8], graduate start-up[9] HEI owned, non-HEI owned. Number of active firms, estimates employment, turnover, investment received	**Models 2 and 3 / *Output oriented***

[1] Public funding: UK Department for Business, Innovation and Skills (BIS) research councils, royal society and British Academy, other UK government departments, EU government, and others.

[2] In-kind: contributions to the project from the non-academic collaborators.

[3] Non-public funding and research councils.

[4] Employ fewer than 250 employees worldwide (including partners and executive directors), and has either an annual turnover not exceeding 50m Euros (approximately 42m British Pound), or an annual balance sheet total not exceeding 43m Euros (approximately 36m British Pound), and conforms to the following independence criteria: no more of 25% of the capital or the voting rights is owned by an enterprise falling outside the definition of an SME (HEFCE, 2011).

[5] One day is equivalent to one person receiving eight hours of teaching/training.

[6] Active (registered under licence to an external party) and live patents.

[7] Spin-offs are defined as companies set-up to exploit IP that has originated from within the HEI.

[8] Staff start up are defined as those companies set-up by active (or recent) HEI staff but not based on IP from the institution.

[9] Graduate start-ups include all new business started by recent graduates (within two years) regardless of where any IP resides.

Social, community and cultural engagement	**Public lectures, Performance arts, Exhibitions, Museum education, Other**	Number of Attendees (free events, chargeable events), staff time	**Model 1 / *Output oriented***

Table 3: Areas and indicators measured in the HE-BCI and their links to the models of knowledge transfer

While some attention is paid to knowledge transfer and knowledge-producing interactions between universities and industry, in line with "model 3", several important types of direct interactions between university and industry personnel are not included, such as graduate placements in industry, recruitment of university staff members to industry positions, academics' participation in industry conferences and workshops, placements of entrepreneurs and industry personnel in universities, visiting scholarships, etc. (see other channels or routes to knowledge exchange in Dutrénit et al., 2010; Hughes et al., 2011; Boardman & Ponomariov, 2009; Jensen, R., Thursby & Thursby, 2010; Bekkers & Bodas Freitas, 2008), which may also be particularly important in disciplines that are applied in nature (such as architecture, design, engineering, medicine and others). Furthermore, interactions around production and service activities, such as prototyping, testing and design services, would fall within the very generic area of "Facilities and equipment related services" where they would be grouped with standardized, non-knowledge producing services like room and equipment rental activities.

Model 1 of knowledge production and transfer is acknowledged to some extent by including publicly-funded contracts which involve non-academic partners, publicly-funded regeneration programmes and knowledge-dissemination activities in the humanities and social sciences. However, these activities remain quite marginal in the survey: not only do they represent, together, only 22% of the overall indicators, but the impact of publicly-funded programmes is mostly measured on the basis of the funding they attracted, neglecting other outputs (for example, collaborative research can produce joint university-industry publications, support joint workshops and other openly disseminated outputs, and regeneration programmes can have many valuable impacts on the community). This approach may reflect the belief that outputs that are openly disseminated do not produce economic impact (this would be consistent with the choice to neglect forms of intellectual property that are non proprietary), a view that has, however, been disproved by evidence (for example, numerous industry surveys have found that firms find "open science" channels such as scientific publications and academic conferences as the most important ways to access academic knowledge; see among others (Arundel & Geuna, 2004; Mowery & Sampat, 2005; D'Este & Patel, 2007; Abreu et al., 2008; Bruneel et al., 2009). It may also reflect a concern with keeping a clear distinction between outputs that result from research activities (such as publications) and outputs from knowledge transfer activities, where in practice such distinction is not so easy to make (for example, several knowledge transfer activities included in the HEBCI survey, such as university-industry collaborations and regeneration/development programmes, often have an important research component).

Hence, the choice of areas appears to reflect a view of knowledge transfer strongly inspired by model 2 (in particular emphasizing patents and software licenses), partly inspired by model 3 (but not inclusive of all possible interactions), and inclusive of model 1 only in relation to the funding attracted to the university and not to the outputs generated which, being disseminated openly, are considered as having little economic impact or to belong to the realm of pure research more than to knowledge transfer.

Moreover, the choice of indicators is strongly biased towards output-oriented measures. Knowledge is seen as information that is linearly transferred from the university to its external partners, not as an interactive process that can generate short and long term benefits for both parties and whose outcomes depend on the quality of the interactions themselves. Hence, the characteristics and quality of the interactions through which knowledge transfer takes place (for example their duration, the number of partner organizations and people involved, the partners' satisfaction with the interactions, their perception of what they learned from the interactions and the short and long term benefits they received) are not considered. Although it was claimed that the dataset provides valuable and in depth commentary on the extent of knowledge exchange in the UK, the mechanisms being put in place are only representing uni-directional knowledge transfer from the HEIs, and no attempts are made to explore the benefits that universities derive from their interactions with external partners (besides the income received).

3.3 An illustration using HE-BCI survey data

First, we show that universities with different knowledge transfer objectives focus relatively more on areas of knowledge transfer that are consistent with their objectives, and hence different institutions have different knowledge transfer profiles that may not all be captured well by the chosen indicators. Universities participating in the survey were asked to state their main objectives, choosing three out of 13 possible options.[vii] By applying a hierarchical clustering algorithm to these 13 variables, we have clustered universities into 7 distinct groups according to their key objectives, as shown in Table 4. Universities in the first four groups have a national or global focus, although with different emphasis; universities in the last three groups have predominantly a local focus.

Cluster	Main knowledge transfer objectives	N. uni	% uni
Research-focused	Supporting business via research and technology transfer	48	29.81%
Education mission	Widening access to education and meeting demand for skills	56	34.78%
Broad mission	Support for SMEs, education and research	28	17.39%
Public mission	Access to education and disseminating knowledge	5	3.11%
Local business support	Focus on SMEs and regional employment and partnerships	15	9.32%
Local community development	Focus on attracting students and building community links	7	4.35%
Local skills development	Focus on local partnerships, management development and regional competences	2	1.24%

Table 4. Clustering universities according to their knowledge transfer objectives

Figure 1 shows the income composition of the universities in each cluster. We can see that the universities' activities are consistent with their objectives. In fact, universities with research focus derive a greater share of income from contract research, while universities with public mission focus derive proportionally more income from collaborative research funded with public funds. Universities focused on education and on a broad combination of missions have more varied portfolios of activities. Universities with local focus derive proportionally more income from CPDs, and some of them also from consultancy activities.

This suggests that universities with different objectives tend to focus on different areas of knowledge transfer. Since the set of knowledge transfer activities considered is not exhaustive, and indicators are strongly biased towards output-oriented measures, universities that focus on the activities that are measured less accurately (or that are completely overlooked) may not be able to correctly represent their engagement in knowledge transfer.

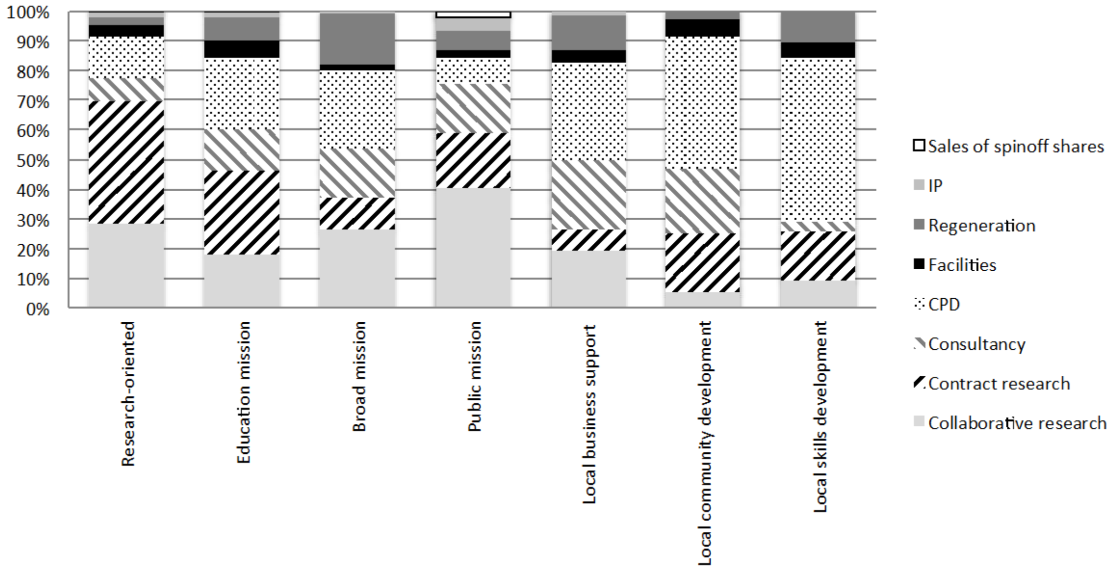

Figure 1: Income composition in the various clusters

Second, we present some figures to support our argument that measuring and rewarding knowledge transfer performance on the basis of the overall income they receive (output-oriented measures) can be misleading, as this variable depends on institutional characteristics like size and possibly disciplinary orientation, rather than capturing the effectiveness and efficiency of knowledge transfer performance. Different universities derive, on average, different amounts of income from the different activities. As can be seen from figure 2, research-oriented and public mission-oriented universities obtain on average higher income from most activities, hence in the current system their performance would be better rewarded. While greater income may be due to these universities being more successful and more efficient performers of knowledge transfer, it may also be due to different reasons that are not linked to greater effectiveness and productivity: (i) universities in these clusters may be larger and hence able to perform more of each activity (hence, the current system rewards universities with larger scale of operations); (ii) universities in these clusters may focus on activities that are more remunerative. Hence, universities that focus on areas where income is not relevant (such as free events) or it is not measured, may be under-rewarded for their knowledge transfer performance.

If these reasons were prevalent, the system would reward the universities that earn more from their knowledge transfer activities due to their scale of operations and their focus, not necessarily those that use their resources to transfer knowledge most productively.

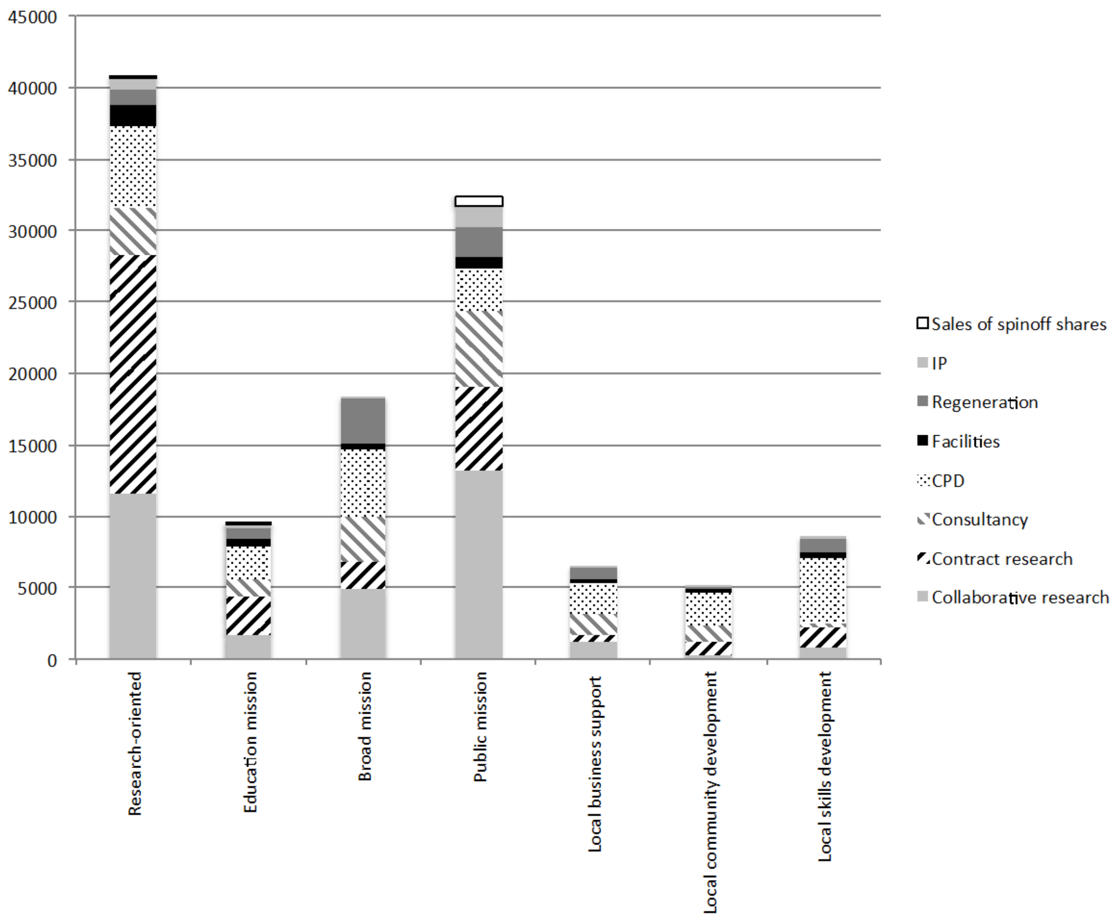

Figure 2: Average incomes in the various clusters (£000s)

To shed some light on the last point, we have compared the average sizes of universities in the various clusters, considering both the number of academic staff and of Business and Community engagement staff. We found that the universities that have the highest average income in most income categories – research-oriented and public mission universities – are also on average the largest in terms of academic staff. Number of academic staff differs significantly across clusters (ANOVA: $F(6,154) = 5.45$, $p = 0.000$). The number of academic staff is positively correlated with all types of income, with most correlations above 0.5. Number of Business and Community engagement staff differs significantly across clusters (ANOVA: $F(6,154) = 2.91$, $p = 0.0103$). Also the number of Business and Community engagement staff is positively correlated to all types of income, but most correlations are below 0.5. So there is some support for the argument that one of the reasons explaining universities' greater income is purely their larger size in terms of academic staff.

If the income obtained for each activity is normalized by the number of academic staff and by the number of services provided (it was not possible to do this normalization for all types of activities due to some information on number of services being unavailable), the results in terms of relative performance change. The clusters that have on average the highest income (research oriented and public mission universities) do not always have on average the highest income per academic staff or per unit of service provided[viii].

Therefore, if the universities' performances were rewarded with respect to the income produced per unit of input, rather than in absolute terms, the distribution of rewards would be different. Figure 3 shows the range of rankings that each cluster would occupy, with respect to each area of knowledge transfer, when the rank is computed using either absolute income (the rank when income is used is indicated with a triangular marker), income per academic staff or income per unit of service provided. We can see that in most cases the difference in rank is three positions or more (position 1 indicates the highest rank).

The ranking of the best performing clusters would change also if we focused on indicators of engagement (number of contracts, number of services offered, number of days of CPD training offered, number of attendees at events) rather than on income. Universities in different clusters have very different profiles in terms of engagement in knowledge transfer: research-oriented universities are ranked first in terms of average number of research contracts, broad mission universities are first in terms of average number of consultancy contracts and of CPD learner days delivered, education-oriented universities are ranked first in terms of average attendees at public events while universities with a local business support mission are first in terms of average facility and equipment services provided. So if the universities' performance was rewarded with respect to engagement in all types of knowledge transfer activities, rather than just of a subset of income-producing activities, the distribution of rewards would in all likelihood be different.

4 Conclusion: problems with current indicators

This paper highlighted several competing views and characteristics of "what is" academic knowledge, and to what extent these models impact the measurement of universities' knowledge transfer performance. This evidence has opened up an important line of enquiry into the distinctive features of knowledge transfer models, which may influence the types of indicators used to measure knowledge exchange activities.

First, it has been argued that indicators should relate to all forms of knowledge transfer activities, in order to allow universities of different types to represent their knowledge transfer activities accurately. Instead, policymakers are often driven by a narrow view of what knowledge transfer processes entail. We have shown this with reference to the case of the UK, where we have argued that the choice of areas of knowledge transfer to be measured is strongly inspired by the model of knowledge transfer based on intellectual property rights (in particular emphasizing patents and software licenses); it is partly inspired by the interaction-based model (but not inclusive of all possible interactions);

and it includes the model of knowledge transfer based on open dissemination only in relation to the funding attracted to the university and not to the knowledge outputs generated. This has led the policymaker to focus on a range of knowledge transfer activities that is not comprehensive. Indeed, it has been acknowledged through reports by UNICO (Holi et al., 2008) and Wellings review (2008) to name a few, that certain types of activities have been undervalued, such as visiting scholarship placements, or even knowledge disseminated through open source licenses.

Our evidence confirms that institutions have different objectives and they pursue knowledge transfer strategies that are in line with those objectives. In order to ensure comparability between institutions, great care must be taken in the choice of indicators that are not biased in favour of institutions that adopt specific knowledge transfer strategies. One possible approach could be to recognize these differences and use different sets of indicators for different groups of institutions, rather than apply the same narrow model of knowledge transfer indifferently to all institutions. An alternative approach could be to develop a very broad range of indicators taking into account all possible activities, and allow universities themselves to choose the profile of knowledge transfer engagement that suits them best (adopting a flexible approach to measurement as suggested, in the more general case of innovation policy indicators, by Rafols et al., 2012).

Second, it has been argued that in order to achieve the potential benefit of having a comprehensive measurement of university knowledge transfer, output oriented indicators alone are inadequate. In particular, we suggest that the value of knowledge transfer is not fully captured through monetary measures. If the objective of the assignment of knowledge transfer funding is to reward broad, effective and efficient knowledge transfer, rather than the institutions' ability to achieve a large scale of operations and to focus on remunerative activities, it would be more appropriate to consider more composite ways to assess performance rather than purely income-based measures.

Third, the aggregation of indicators also presents several problems. Summing indicators, in particular, would not make sense when the units of measurement are not comparable, or when the measured activities are partly substitute or complementary with one another (Bonaccorsi & Daraio, 2008). The need for more flexible ways of aggregating performance indicators has been acknowledged with respect to general indicators of innovation (Stirling, 2003; Grupp & Schubert., 2010) and also to indicators of universities' performance, where some authors have argued in favour of multidimensional measurements (F. A. van Vught & F. Ziegeleeds, 2012) and positioning indicators (Bonaccorsi & Daraio, 2008).

Finally, the choice of areas and indicators and the use of a single formula to reward knowledge transfer performance may have a powerful performative effect, inducing universities to conform to a single model of knowledge transfer (skewed towards research commercialisation and income-producing activities, disregarding the full spectrum of knowledge transfer activities), reducing variety and possibly negatively affecting amount and quality of knowledge transfer that takes place. These potential negative feedback effects should also be taken into account when designing a comprehensive system of assessment of universities' knowledge transfer performance.

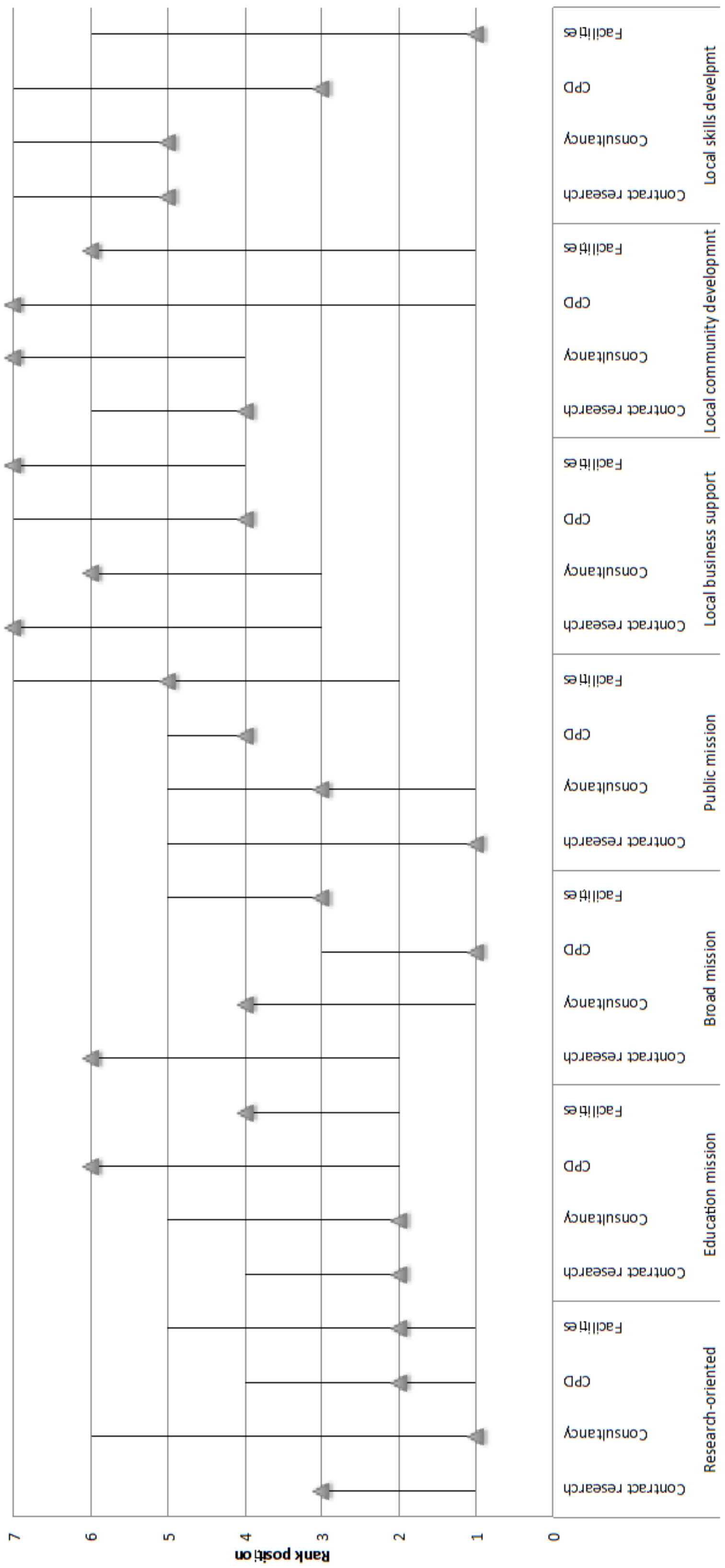

Figure 3: Sensitivity of rank position of university clusters according to different types of performance measurement (level of income, income per academic staff, income per unit of service provided)

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[i] According to this model, which emerged at the beginning of the 20th century and was codified in its current form between 1940 and 1960 (Godin, 2006), the innovation process is composed of a sequence of stages performed by different organizations (from universities that perform basic research to firms that engage in development, production and marketing, to users that adopt the final products): knowledge in this context is seen as perfectly transferrable, flowing easily from one organization to another in the various stages of the innovation process.

[ii] Indeed, Thursby et al. (2001), in a survey of 62 US universities, found that 71% of the inventions licensed from the university to firms required interactions with the inventor in order to be subsequently commercialized.

[iii] Currently in the US, the indicators focus solely on licensing activities at US and Canadian universities, hospitals and research institutions, based on data collected by the Association of University Licensing Managers (AUTM). Australia on the other hand is following closely on the indicators being used in the UK (see Jensen et al., 2009).

[iv] Such as the Higher Education Innovation Funds (HEIF) in England, the Innovation and Engagement Fund in Wales, the Knowledge Transfer grant in Scotland and the Higher Education Innovation Funds (HEIF) in Northern Ireland.

[v] Since 2009, the survey has been collected and validated by the Higher Education Statistics Agency (HESA).

[vi] Excluding pre-registration funded by the National Health Service (NHS) or Training and Development Agency (TDA).

[vii] Access to education, Graduate retention in local region, Technology transfer, Supporting small & medium size enterprises (SMEs) Attracting inward investment to region, Research collaboration with industry, Attracting non-local students to the region, Support for community development, Developing local partnerships, Management development, Meeting regional skills needs, Meeting national skills needs, Spin-off activity.

[viii] According to Kruskal-Wallis tests performed on all these variables, most have significantly different means across the clusters (except for consultancy income per academic staff, CPD income per academic staff, facilities income per academic staff, sale of spinoff shares per academic staff, and consultancy income per contract).